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Bone Cysts (Ostitis Fibrosa): Variety---Polycystic Ostitis Fibrosa

An Infflammatory Lesion of the Marrow Tissue of the Shaft of Bones Before Ossification of the Epiphysis

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CONTENTS:

Brief Summary of Five Cases
Clinical Picture of Bone Cysts
The X-ray of Bone Cysts
Gross Pathology of Bone Cysts
Healing of the Bone Cyst
Cases of Polyscystic Ostitis Fibrosa in Detail
Methods of Attack in Central Bone Lesions
Registration of Bone Tumors by Dr. Codman of Boston
Closure of Wound
X-ray and Radium Treatment

I WISH to report in this paper five cases which differ from the ordinary bone cyst in the gross and microscopic pictures of the inflammatory tissue filling the bone shell. The term *polycystic ostitis fibrosa* seems descriptive.

Brief Summary of the Cases

Case 1—(Pathol. No. 11466)—Operation by Dr. L. W. Hotchkiss at Bellevue Hospital, New York, December, 1910. Lesion in lower end of tibia involving the epiphysis. White male, aged 23; duration of swelling, four years; operation, curetting; ultimate result not ascertained. (See Figs. 1 to 8). Some pathologists might look upon this case as hemangioma cavernosum of bone.

Case 2—(Pathol. No. 12838)—Operation by Dr. William Baer at the Church Home Hospital, Baltimore, May, 1912. The tumor involved the spine of a dorsal vertebra in a white male aged 17. The symptom, pain, had been present seven months. The tumor was partially removed. This patient is well (1922) ten years after observation. (See Figs. 9 and 10).

Case 3—(Pathol. No. 12378)—Operation by Dr. S. T. Mixter of Boston in April, 1910. The lesion involved the crest of the ilium, which was partially removed. The patient has been well (1922) twelve years with exostoses in the area of the old lesion which give no symptoms. (See Figs. 11, 12 and 13).

Case 4—(Pathol. No. 25892)—Operation was performed by Dr. James M. Hitzrot of New York, January, 1916, and was reported by him with illustrations in the *Annals of Surgery*. [1] The lesion involved the upper third of the shaft of the humerus and was diagnosed by Drs. Elser and Ewing as hemangioma cavernosum. The operation consisted of partial excision without destruction of the continuity of the shaft. (See Figs. 14 and 15). I saw this patient in December, 1920, because of recurrence of pain and loss of function. Nothing was done, and the patient is well (1922) six years after the original operation.

In these four cases there was but one focus found.

Case 5—(Pathol. No. 29834)—Operation by Dr. Ghormley in Dr. Baer's orthopedic service, Johns Hopkins Hospital, March, 1922.

In this case the lesions were multiple, in the lower end of the tibia and fibula and in the metatarsal bone of the great toe of the left foot. At the operation the lesion in the metatarsal only was curetted. (See Figs. 16 and 17).

Clinical Picture of Bone Cysts

Group 1: The majority of cases are under 15 years of age. If older than 18 the symptom of onset, as a rule, dates back to a period younger than 18. Von Mikulicz was the first to emphasize the fact that the benign bone cyst is a disease of the juvenile bone. In more than 50 per cent of the cases the young individual experiences no pain and observes no swelling or loss of function, until, after a trauma producing fracture, an x-ray is taken and the central lesion revealed. Now and then there is a case having a history of a healed fracture of which no x-ray was taken at the time of the injury, but after the occurrence of a second fracture an x-ray brings the first lesion to view. In a few cases there have been repeated fractures with healing, without x-ray examinations, until finally, after a recurrent fracture or swelling, the diagnostic x-ray is made.

Therefore, in the larger number of bone cysts fracture is the symptom of onset.

Group 2: In a smaller number of cases within the same age limits as in the first group there is no history of fracture, and the patient comes under observation and x-ray because of an observed swelling or expansion of the shaft of a long bone, usually near the epiphysis. Such cases are usually located in the upper end of the tibia, in the radius and ulna, or the fibula.

Group 3: In groups one and two the history and the examination find but one focus. In a very few of these, x-rays of the entire skeleton may reveal another small cyst involving a second bone.

Group 4: The clinical picture is that of multiple lesions of bone, often with the history of repeated fractures in one bone after another; these heal. Or there may be multiple swellings without fracture. The x-ray makes the diagnosis, as in groups one and two.

Group 5: Here so many bones are involved that we must look upon it as a disease of the entire skeleton. This group is infrequent. It was first described by von Recklinghausen as ostitis fibrosa of the entire skeleton. I have reviewed the literature of this group in 1910 [2] and there is a recent article by John L. Morton. [17]

Group 6: Bending or bowing of a single bone may be the symptom of onset; later there may be fracture. Kammerer of New York was first to describe such a case.

Group 7: When the patient comes under observation there may be but a single huge swelling or expansion of the involved area, the symptom of onset, swelling, dating back to the age of adolescence. I have described and

*—Received for Publication September 26, 1922.

Fig. 1—Case 1—Pathol. No. 11466—X-ray before operation. Polycystic ostitis fibrosa.
Fig. 2—Case 1—Pathol. No. 11466—X-ray before operation. Polycystic ostitis fibrosa.

illustrated these in the *Annals of Surgery.* [2]

Group 8: Here is found the latent or unhealed bone cyst, observed in adult life. Recently a number of adults have come under my observation who, because of a recent trauma or pain in a bone, have had x-rays taken, and a central lesion of the bone brought for the first time to the light. This group I have discussed in *Minnesota Medicine.* [3]

Group 9: In two instances the clinical picture of the bone cyst near a joint has been obscured by infection and the symptoms suggested arthritis or osteomyelitis.

Group 10: In one instance the bone cyst had completely ossified, but the swelling had not disappeared twenty years after its first appearance. [4]

Age, therefore, is the greatest help in the diagnosis of a bone cyst, if the patient is under 15. After that the age is not helpful.

Fracture as a symptom of onset is very suggestive of the bone cyst, and so is bending, but both, *especially fracture, are observed in every type of central bone lesion.*

Pain: In bone cysts pain is not a prominent symptom, except when there is a recent fracture, when it may be intense until the fracture is fixed. The presence or absence of pain, therefore, is not of diagnostic value.

Tenderness: This is rarely present except with recent fracture.

In central sarcoma, in multiple myeloma and in metastatic carcinoma of bone, pain and tenderness are more frequently observed than in the bone cyst or in the central giant-cell tumor.

Loss of Function: This is never present, except with fracture, or when the cyst is near the joint, especially in the head of the femur, when the bone expansion may interfere with function.

Fig. 3—Case 1—Pathol. No. 11466—Painting made from original tissue removed from the bone cavity shown in Figs. 1 and 2. Some of the cavities contained blood clot.

Palpation: When the x-ray shows an intact bone shell, the soft parts outside of the bone on palpation feel as normal tissue. In the two cases in which the cyst was infected this was not so; here the soft parts were infiltrated.

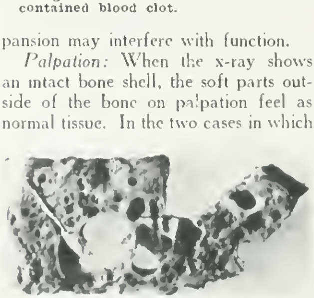


Fig. 4—Case 1—Pathol. No. 11466—Photograph of gross specimen removed from the bone cavity shown Figs. 1 and 2. Typical picture of polycystic ostitis fibrosa.

In the majority of cases of bone cysts the expanded area feels like bone. Now and then the shell may be so thin that parchment crepitation is made out, or there may be places where the bone shell is absent. In a few instances a definite perforation could be palpated. Pulsation has never been noted. If fracture is present, there may be crepitation.

There is nothing of diagnostic value in the palpation of the shell of bone covering a bone cyst, as compared with palpation in the giant-cell tumor, the central myxoma and chondroma, the sarcoma, multiple myeloma and metastatic carcinoma. It is true that definite parchment crepitation is more often observed in the benign bone cyst.

When one can see in the x-ray a central tumor with an intact bone shell and then can palpate in the soft parts outside the shell a definite tumor or a definite infiltration, this indicates either a sarcoma, an infected bone cyst, tuberculosis or a Brodie abscess.

The chapter, however, on palpation of the soft parts about a central bone lesion with intact bone shell cannot be written until we have more accurate records, and I take this opportunity to urge clinicians and roentgenologists not only to palpate carefully, but to make a clear record of what they feel.

I can find nothing characteristic in the different types and shapes of the expansion of the bone shell. It may be gradual or abrupt; it may be smooth or irregular; it may be present on all sides, or on only one side of the bone involved, in the different types of central bone lesions.

Multiplicity: The demonstration in the x-ray of multiple central lesions excludes primary sarcoma. The patient with multiple myeloma or metastatic hypernephroma as a rule has Bence-Jones bodies in the urine, is an adult, and shows definite symptoms of cachexia. In the multiple metastatic carcinoma the patient is an adult and as a rule there is a history, or evidence, of a primary tumor elsewhere. In younger individuals, in a few instances, the multiple central tumors have proved to be chondromas.

X-RAY OF BONE CYSTS

Since 1899 I have followed the literature on the x-ray diagnosis of a single, central tumor with an intact bone shell, and I have never been willing to accept the definite concluion of some authorities that the x-ray picture of a bone cyst was characteristic; and now that my experience is very much larger I am still unable to furnish any evidence that the different types of central bone lesions have anything characteristic in

the x-ray picture. It is true, the localization of the lesion is helpful. The bone cyst rarely extends into the epiphysis through the epiphyseal line, while the giant-cell tumor and central sarcoma usually do. But there are exceptions in both. (Note—The x-ray of metastatic hypernephroma is beginning to seem characteristic).

Perforation of the Shell: In many reports received from roentgenologists, when perforation of the shell could be made out in the x-ray, this was looked upon as suggestive of malignancy, or even pathognomonic. But the older literature which I have reported in *Progresive Medicine* from time to time, records numerous instances of perforation in the benign bone cyst. True, these were older cases, but I have observed it in small cysts of recent origin.

Partial or Complete Destruction of the Bone Shell: It is true that this is more frequent in the giant-cell tumor, in sarcoma, myeloma, metastatic tumor and in myxoma, but it may be observed in the bone cyst.

Evidence of New Periosteal Bone Formation Outside the Bone Shell Not to be Explained by Fracture: This is most frequently observed in sarcoma. So far I have never observed it in the giant-cell tumor, and I thought it never occurred in the bone cyst, until recently Dr. Codman showed me a case of multiple bone cysts in which new periosteal bone formation could be seen in the x-ray outside the bone shell of one of the cysts.

Perhaps a larger number of cases and a more critical study of the x-rays may bring to light some pathognomonic changes in the central bone tumors, but at present my experience warns me not to rely too implicitly on the x-ray picture only. This point has been discussed, with illustrations, in *Minnesota Medicine.* [3]

Healing of Fracture: This is not diagnostic. It has been observed in every type of central bone lesion.

Gross Pathology of Bone Cysts

In the *Annals of Surgery* [2] and in the *Transactions of the American Surgical Association* [5] for 1910 I classified the gross findings, on opening the bone shell, into six main groups, with illustrations.

Group 1: Cutting down upon the bone shell reveals no change in the soft parts. On stripping back the apparently normal periosteum the surface of the bone is not white, with pin-point hemorrhages from the Haversian canals, but dark, like the bark of a tree, and there is no hemorrhage. On removing the shell of bone there is found to exude, under no pressure, a viscid, serous fluid, sometimes slightly brownish stained. In my experience this fluid has never been bloody. But if there has been a recent fracture there may be a small blood clot or two. When one curets the bone shell, there is no connective tissue lining. Now and then one may find in a little recess some friable, red granulation tissue which in the gross, resembles the giant-cell tumor, and under the microscope, contains giant cells. [6] When one makes a section of the bone shell, the Haversian canals are filled with a fibrous cellular connective tissue, abnormal for bone, but histologically identical with the connective-tissue lining of Group 2.

I know of no other bone lesion which has a gross picture similar to this.

Group 2 When the bone shell is removed one comes in contact with a definite connective tissue of the consistency of leather. It varies in thickness from a few millimeters to a centimeter or more. On perforating this connective tissue lining the same type of fluid as in Group 1 is encountered. In a few instances I have observed on the inner surface of the connective tissue lining a covering of snow-white granular material of calcium salts.

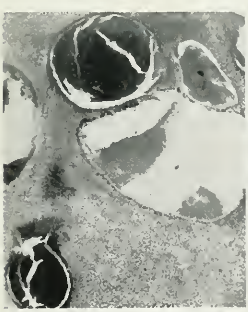
Pathol. No. 19179, in a previous number of the Journal, [7] beautifully illustrates this connective tissue lining within the bone shell, but the case was incorrectly diagnosed a malignant bone cyst. The x-ray of the bone cyst shown in Figure 2 of the same issue of the Journal had a similar connective tissue lining. Now that I have restudied and rediagnosed Pathol. No. 19179 I can state that sarcoma occurring as a bone cyst never has this leathery connective tissue lining.

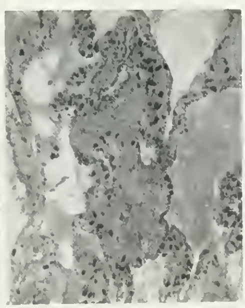
Group 3: The connective tissue lining is so thick that there remains but a single small cyst, or a few multiple cavities *(polycystic ostitis fabrosa).* Figure 6 in the *Annals of Surgery* for August, 1910, pictures such a case with a single small cyst, and Figures 3 and 4 in this paper show a polycystic type. I have never observed sarcoma to have this gross appearance.

Group 4: Solid Ostitis Fibrosa. The bone shell is completely filled with a leathery, white connective tissue, pictured in Figure 8 in the *Annals of Surgery* for August, 1910. Figures 32 and 89 in the *Journal of Radiology* for March, 1920, belong to this type. Their gross and microscopic pathology has been illustrated in the *Southern Medical Journal.* [8] This small group of solid ostitis fibrosa has been mistaken in the gross and in the section for sarcoma. [9]

Codman of Boston in his registration of bone sarcomas finds a few examples of this type reported to him as cases cured after amputation.

This Group 4, solid ostitis fibrosa, is therefore a very important one to be critically and repeatedly studied by pathologists and surgeons in order to avoid an unnecessary resection or amputation for this benign lesion. I reported and illustrated in the *Journal of Radi-*





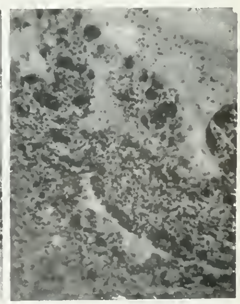


Fig. 5—Case 1—Pathol. No. 11466—Microscopic picture low power) showingc cysts filled with blood and debris with many osteoblasts in the wall of the cysts. For high power see Fig. 6.

Fig. 6—Case 1—Pathol. No. 11466—Microscopic picture high power) of area shown in Fig. 5. Shows fibrous and cellular areas of ostitis fibrosa, a giant cell, and near the cyst, numerous osteoblasts.

Fig. 7—Case 1—Pathol. No. 11466—Microscopic picture showing the smaller cyst. and numerous osteoblasts in a cellular ostitis-fibrosa tissue.

Fig. 8—Case 1—Pathol. No. 11466—High power picture of a cellular area with numerous giant cells, not unlike the picture of the giant-cell tumor.

ology [10] a type of central fibrosarcoma resembling somewhat in the gross and in the section solid ostitis fibrosa.

Group 5: Multilocular Cysts. These are observed chiefly in the huge bone cysts. But this group I now place with Group 3, polycystic ostitis fibrosa.

Group 6: In the *Annals of Surgery* [2] I placed in this group a number of miscellaneous cases: A, infected bone cyst; B, x-ray studies only, no operation. This group, 6-B, has increased from five cases in 1910, to seven in 1922; C, autopsy specimens, all of the huge type, and as nothing was preserved but the bone shell, a classification as to connective tissue lining could not be made; D, healed bone cyst. Here, on exploration the area within the bone shell has completely ossified.

With the exception of Group 4, solid ostitis fibrosa, there should be no difficulty in recognizing the different gross types of the benign bone cyst when the bone shell is removed.

HEALING OF THE BONE CYST

This will receive but brief mention here. I have discussed it in the *Southern Medical Journal.* [8]

We now have a number of cases in which a diagnosis of a bone cyst has been made from the x-ray. The patients have been followed, there has been no fracture, except the original one, if any, and ossification has finally taken place. There seems no doubt that the tendency of the inflammatory lesion, whatever its cause, is finally to ossify, and the bone is finally restored to almost normal.

I now have record of the ultimate results in practically every case, whether operated on or not, and in the majority of cases an x-ray of the permanent result. In a few the bone is restored to absolutely normal; a few show bending; a few show unhealed light areas. This study of the healing of the bone cyst brings out one fact very clearly. If there is a fracture, with few exceptions, complete healing will take place. I observed one bone cyst of the femur for a period of fifteen months. During this time it showed but slight ossification; a fracture took place, and there was complete ossification in six weeks.

Fig. 9—Case 2—Pathol. No. 12838—Polycystic ostitis fibrosa in spinous process of vertebra. Photograph of two of the pieces removed at operation. Note the thin bone shell and the minute cystic cavity in the tissue beneath.

I have used this as an indication for operation: If the patient is under 15, and there is a fracture, do not operate; the x-ray pictures will undoubtedly, later on, picture the ossification. If there is no fracture and the x-ray shows little or no ossification, operate, and the chief point of the operation is to produce a fracture. In large bone cysts the thin bone shell can be crushed, as suggested in the older literature, which I have successfully done in a few large cysts in the upper end of the tibia.

The complete ossification of a bone cyst, especially when there has been no fracture, or but a slight one, or after an operation in which the fracture made was slight, may be slow. In one example of cyst of the shaft of the humerus, the series of x-rays demonstrated that complete ossification was not accomplished until at the end of three years.

The huge bone cyst which I reported in the *Annals of Surgery* [2] and a few more in the *Journal of Radiology* [11] are evidence that in some instances ossification does not take place and expansion of the bone shell may go on, with so much destruction that only an amputation will relieve the condition. As pointed out in the *Annals of Surgery* [2] attempts at resection in these huge bone cysts are associated with so much oozing of blood during or after operation, that death from hemorrhage has occurred.

Therefore, if the x-rays show an increasing expansion of the bone shell, or increasing involvement of the shaft, operation should not be delayed.

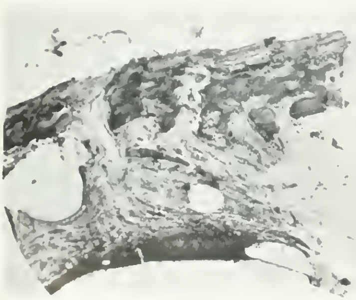
Recurrences After Operation for Bone Cysts: Now and then, after conservative operation, curetting or letting out the fluid, second operations have been performed because of refracture or slow ossification. As I restudy these cases, I am inclined to the view that the second operations were unnecessary, and were due to an incorrect interpretation of the x-ray picture and lack of knowledge of the slow ossification of the bone cyst.

POLYCYSTIC OSTITIS FIBROSA

Case 1—(Pathol. No. 11466)—Figs. 1 to 8: Lesion in the lower end of the tibia involving the epiphysis. Male, aged 23. Operation, December 10, 1910, by Dr. Hotchkiss, Bellevue Hospital, New York. Ultimate result not ascertained.

In Figure 1 the anteroposterior view, we observe that the lower third of the shaft of the tibia, extending through to the epiphysis of the internal malleolus is involved. The bone shell is intact; there is no new periosteal bone formation. The shadow suggests a polycystic condition. The tibia, towards the fibula has a thicker bone shell.

Figure 2: Lateral view. We now see that the light shadow extends to



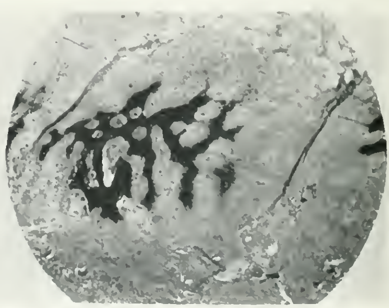


Fig. 10—Case 2—Pathol. No. 12838—Polycystic ostitis fibrosa. Microscopic picture (low power). For gross appearance see Fig. 9. Note the minute cavity, the islands of bone and the cellular and fibrous ostitis-fibrosa tissue.

Fig. 11—Case 3—Pathol. No. 12378—Photograph of gross tissue removed from a bone shell in the ilium. Note the leathery connective tissue filled with minute cavities. Some of these contained blood. Compare with Fig. 4, polycystic ostitis fibrosa.

Fig. 12—Case 3—Pathol. No. 12378—Microscopic picture (high power). Note the islands of bone and the cellular and fibrous ostitis-fibrosa tissue.

the cartilage of the ankle-joint, and the whole lower end of the tibia is expanded and involved, with a thin bone shell. There is no evidence of perforation, or of new periosteal bone formation. The polycystic appearance seen in Figure 1 is less distinct. The shadow of the central area below is not sharply outlined from the marrow shadow above. As I have only a print and not the original x-ray, this lack of differentiation may be due to the print. We have here a distinct x-ray picture of a central bone lesion with intact bone shell, and when I compare it with others in this area and in other bones I can record that this x-ray is not pathognomonic of a benign bone cyst, and I have the x-ray of a central sarcoma of the upper end of the humerus with intact bone shell which resembles it. The involvement of the epiphysis is against a bone cyst.

Dr. Hotchkiss sent the following clinical note: "The patient is a white male, aged 23. He has observed a swelling of the internal malleolus for four years; this has gradually increased in size; there has been some pain on walking. On inspection one can see an oval tumor involving the malleolus and five centimeters of the shaft. On palpation the tumor feels like bone, smooth, hard; there is no fluctuation, crackling, or pulsation; there is no infiltration of the soft parts. The foot is held in slight inversion, abduction and adduction of the foot are limited. Passive motion elicits pain. The greatest circumference of the swelling of the lower end of the tibia measures three centimeters more than a corresponding area of the opposite leg. The patient was therefore aged 19 at the onset This would favor a giant-cell tumor or a sarcoma rather than a bone cyst. But the duration of the swelling for four years would almost rule out sarcoma. The diagnosis rests between a bone cyst, a giant-cell tumor, a myxoma or a chondroma. The long duration would exclude multiple myeloma or metastatic carcinoma."

Operative Pathology: Dr. Hotchkiss writes that on opening the thin bone shell he enucleated a growth filling the bone cavity. His diagnosis was sarcoma. After this enucleation or curetting, he swabbed with pure carbolic acid.

Healing of the Wound: The wound healed, from my experience, more rapidly than if the lesion had been a giant-cell tumor.

Gross Pathology: Figure 3 is a painting, Figure 4 a photograph of the tissue sent me by Dr. Hotchkiss. The tissue is of the consistency of leather; it is filled with cysts varying from one to eight millimeters in diameter; some of these cavities contain dark clotted blood. The tissue beneath the cavity is firm and leathery and not friable. Only a fibrosarcoma, or fibroma would feel or look like this tissue, but I have never observed multiple cysts of this kind in either the sarcoma or fibrosarcoma. The benign giant-cell tumor is friable, of the consistency of cheese and contains practically no connective tissue. The gross appearance in this case is that of polycystic ostitis fibrosa.

Microscopic Pathology: Figure 5 (low power) :Here we see the cavities, some filled with blood, some empty; between the cavities a cellular tissue with much intercellular eosin-staining fibrous tissue, of the type seen in ostitis fibrosa.

Figure 6 (high power of Fig. 5): The larger cells lining the cavity are chiefly osteoblasts; there are no giant cells of the epulis type. These cells do not suggest the endothelium of blood vessels. The debris in the cavity is old blood and degenerated cells; no calcium.

Figure 7 (high power): There are numerous cavities with and without hemorrhagic debris; the larger cells resemble osteoblasts; the dense cellular tissue about the cavity resembles ostitis fibrosa. There are very few giant cells of the epulis type.

Figure 8 (high power): This area contains numerous giant cells of the epulis type and many osteoblasts; the larger cells are imbedded in very cellular tissue. This area resembles the giant-cell tumor. Such areas are not infrequent in the connective tissue lining of a bone cyst. They can be picked out in the gross as red, friable areas.

We have studied these sections again and again for foam cells and have failed to find them. Figure 8 is not unlike xanthoma, except there are no foam cells and not much blood pigment.

Pathological Report by Dr. James Ewing, Professor of Pathology at Cornell University: "I think this is a true benign giant-cell sarcoma arising in the bone marrow, probably a sequel of ostitis fibrosa cystica. The dilated sinuses represent the early stages of the cystic transformation. They are lined by characteristic epulis giant-cells. Similar cells appear in foci of dissolving calcium fragments. The stroma is a very cellular and almost myxosarcomatous. At certain points the stroma is extremely cellular suggesting a true aggressive tumor."

This was written September 5, 1920. In Dr. Codman's new classification he would place this tumor in the border-line group.

Ultimate Result: About nine months later the patient again came under Dr. Hotchkiss' observation. The wound was healed. An x-ray was interpreted as a recurrence. The patient refused operation, and all attempts to follow him have failed.

From my experience, an x-ray nine months after such an operation would not show complete ossification, whether the tumor was a bone cyst or a giant-cell tumor. Therefore, we have no definite evidence that there was a recurrence.

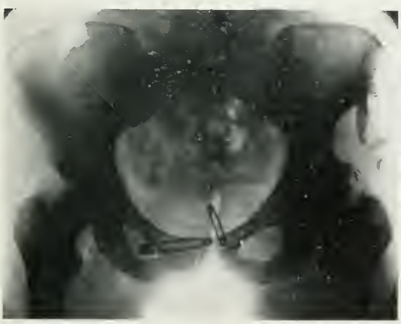


Fig. 13—Case 3—Pathol. No. 12378—X-ray of the result eleven years after operation, showing the ossification of the cavity in the ilium, the numerous exostoses and evidence of bone in the soft parts.

Fig. 14—Case 4—Pathol. No. 25892. X-ray before operation.

Fig. 15—Case 4—Pathol. No. 25892—X-ray of result four years after operation. Original x-ray shown in Fig. 14.

Case 2—(Pathol. No. 12838)—Figures 9 and 10: The tumor involves the spine of the dorsal vertebrae in a white male, aged 17. There had been pain for seven months. At the operation by Dr. Baer in 1912 the tumor could be but partially removed. The patient is (1922) apparently well, ten years later.

Clinical Note: The record in the laboratory is incomplete. It reads: "White male, aged 17; pain in the shoulder blade seven months; worse on stooping, night sweats; shortness of breath; blood-tinged sputum."

Gross Pathology: Figure 9 is a photograph of two of the larger seven pieces received in the laboratory. It shows the distinct very thin bone capsule; the tissue is red and spongy, leathery, filled with minute cavities. The coloring is white, brown and red.

Microscopic Pathology: The old pathological diagnosis was myxoma, but on restudy of new sections (Fig. 10) there is no myxomatous tissue. There is a thin bone shell with areas of bone throughout the tumor tissue; there are numerous cysts; the connective tissue resembles ostitis fibrosa; there are numerous osteoblasts, no giant cells; the tissue is very vascular.

Ultimate Result: In 1913, one year later, the patient writes: "Feeling well; no pain in the back; some palpitation of the heart." In 1919 the patient writes a long letter which is very difficult to interpret. Apparently there is no recurrence of the tumor, but he is suffering from symptoms due to pressure on the cord.

In 1922 the patient is still living. This long period must exclude a malignant disease.

Case 3—(Pathol. No. 12378)—The lesion involved the crest of the ilium. The operation was performed by Dr. Mixter of Boston, in April, 1910. In 1922, twelve years later, there has been no recurrence, but an x-ray showed exostoses from the pelvis in the region of the old scar. (Figs. 11, 12 and 13).

Clinical Note: (Sent by Dr. Mixter in April, 1910). The patient is a white female, aged 19. For six months there has been pain in the region of the right hip. For two months Dr. Osgood of Boston could palpate a mass below the right anterior spine of the pelvis. This palpable area was tender and the seat of pain. At this time an x-ray was reported negative.

Examination: (before operation). A palpable mass below the anterior superior spine of the ilium three centimeters in diameter, above the trochanter. No limitation of motion at the hip joint, but some pain on active and passive motion. An x-ray now shows a shadow outside of the ilium with some roughening of bone.

Operative Findings: A tumor was present in the ilium within a thin bone shell; the soft-part tumor in the bone shell was sponge-like and could be easily removed from the bone shell. Some of the shell was removed and the wound closed.

Gross Pathology: This is very similar to that in Case 1, Figure 4. The cysts are more irregular and less round; the tissue is leathery, like ostitis fibrosa (Fig. 11).

Microscopic Pathology: (Fig. 12). We have the picture of ostitis fibrosa with areas of ossification. Other sections show the polycystic type similar to Figures 5 and 10. Some of the cavities contain blood clot undergoing organization. There are many osteoblasts and a few giant cells. It is difficult to tell whether the bone islands are old bone or new bone.

Ultimate Result: In August, 1921, eleven years later, the patient came under the observation of Dr. Mixter again, and an x-ray (Fig. 13) was taken. It showed the defect in the ilium filled with new bone and from this area two exostoses, some smaller exostoses from the top of the acetabulum, and a few dark shadows in the soft parts, suggesting bone. The new bone in the soft tissues could be easily explained by the transplantation of periosteum or bone during the operation. The larger exostoses were probably due to direct trauma to bone during operation.

The patient is well and free from pain, and there is no limitation of hip-joint motion.

The x-ray taken in August, 1921, is identical with the one taken the year before. She consulted Dr. Mixter because some months before, after mountain climbing, she began to have pain and a limp.

Case 4—(Pathol. No. 25892)—This case was reported in detail by Dr. Hitzrot in the *Annals of Surgery* for April, 1917, with reproduction of the x-ray and four photomicrographs. The lesion involved the upper end of the humerus and was within a bone shell. I reproduce here a copy of the x-ray (Fig. 14) and it should be compared with Figures 1 and 2 of Case 1.

Clinical Notes The patient is a white male, aged 25. He was examined by Dr. Hitzrot in January, 1916, because of pain in the region of the shoulder. The trouble dated back six years to an injury. During this interval there had been intermittent attacks of pain after excessive exercise, and an x-ray taken four years after the injury was reported as negative. The attack of pain here

Fig. 16—Case 5—Pathol. No. 29834—Polycystic ostitis fibrosa of lower end of tibia and fibula and metatarsal bone of great toe. Suspicious smaller areas in other metatarsal bones and in the tarsals.

Fig. 17—Case 5—Pathol. No. 29834—Antero-posterior view showing the polycystic ostitis fibrosa in the lower portion of the shaft of the tibia without involvement of the epiphysis, and lower end of the fibula with involvement of the epiphysis.

Fig. 18—Pathol. No. 25646½—Multiple chondroma of metacarpal and phalanges of index finger and thumb and of lower end of the radium. Compare with Figs. 16 and 17.

recorded had been observed four weeks.

Examination: The deltoid area bulges. It is tender. The upper end of the humerus feels larger, and the palpable bony mass is irregular. On joint motion there is crepitation and pain. The x-ray was interpreted as showing a shell of bone divided by bone trabeculae. The majority of the visible tumor in the x-ray rests upon the old cortical bone of the shaft, but the light areas in the region of the trochanter and head suggest also a central involvement.

The preoperative diagnosis was *myxochondrosarcoma*, or some form of a bone cyst.

Operative Findings: January 11, 1916. The soft parts were uninvolved. There was exposed a thin shell of bone. On opening it there was removed some straw-colored mucoid fluid. The bone shell was lined by a mass of coagulated, slightly altered blood. The marrow cavity of the head and some of the shaft was involved. A small piece of bone was found in the altered blood clot. The inner lining of the bone shell was irregular. The wound was closed with a muscle flap.

Gross Pathology: (Dr. Elser). There is a shell of bone eight by four centimeters; outer surface smooth, inner surface low trabeculae; filling the bone cavity is bloody and necrotic material.

Microscopic Pathology: Organized blood clot. Areas of cells suspicious of sarcoma. Other sections show cavernoma.

Final Diagnosis: Cavernous hemangioma of bone.

Second Operation: In April, 1916, three months later, because of pain and restricted motion after a strenuous game of tennis, an x-ray was taken, and an exostosis was found. At the operation the joint was reopened and a small exostosis near the bicipital groove removed. There was no evidence of the recurrence of the tumor. Other pieces of bone and soft parts were removed for microscopic examination.

Microscopic Pathology: (Dr. Elser). No evidence of recurrence of the tumor. The exostosis is normal bone, the soft parts show foreign body giant cells, and blood pigment.

Ultimate Result: This patient came under my observation in December, 1920, four years after Dr. Hitzrot's operation because of pain and limitation of motion in the shoulder-joint. He had served in the army at the front and his recurrent symptoms again were due to strenuous exercise. An x-ray had been taken at Coblenz, and a German surgeon had diagnosed sarcoma and advised amputation.

The x-ray taken later at the Walter Reed General Hospital (Fig. 15) shows beautifully when compared with the result (Fig. 14) of Dr. Hitzrot's operation. Although there is considerable pain and limitation of motion the x-ray shows no areas of bone destruction and only small exostoses. The present symptoms could be easily explained by the trauma. At first we considered an operation either to remove the head of the bone and transplant, or simply to remove the roughened areas of bone. But as he improved under observation, nothing was done, and the patient is well today (September, 1922) more than two years later.

Microscopic Pathology: Through the courtesy of Dr. Hitzrot I was able to examine the original sections, and I was rather inclined to the view that it was polycystic ostitis fibrosa, as the sections resemble those in Case 1 (Figs. 5 and 6). Dr. James Ewing, however, to whom I again referred these sections and those in Case 1, is of the opinion that this case operated on by Dr. Hitzrot is a definite hemangioma, and the tumor is cortical rather than central. The important point, however, is that the lesion is benign, and, although the operator, because of the x-ray picture, properly considered the possibility of malignancy, he was of the opinion later, when the gross pathology was exposed, that it was benign and treated it conservatively.

Subperiosteal Hematoma: This lesion has been described in the literature, but I have never had the opportunity to explore or study its gross and microscopic pathology. One could imagine after a trauma a hemorrhage beneath the periosteum, or a partial fracture with hemorrhage, and this hemorrhage might continue producing bone expansion, with the development of a true cyst filled with organized blood clot. This might give a picture similar to Figure 14 in the x-ray.

Case 5—(Pathol. No. 29834)—Figs. 16 and 17: This observation differs from the other four cases in that three bones are involved—the lower end of the tibia and fibula and the metatarsal bone of the great toe. The x-rays (Figs. 16 and 17) show expansion of the metatarsal and a very mottled area in the region of bone involvement.

Clinical Note: The patient was admitted to Dr. Baer's orthopedic service at Johns Hopkins Hospital, and the first metatarsal bone curetted by Dr. Ghormley, the orthopedic resident. Patient was a colored boy, aged 12. There was a history of trauma six months before, following which there was swelling, pain and limp. On palpation there was found an expansion of the metatarsal bone of the great toe which felt like a bone shell. There was nothing to be made out on palpation of the lower end of the tibia and fibula. The Wassermann was positive, but the bone lesion did not improve under salvarsan. The x-ray (Figs. 16 and 17) was diagnosed multiple chondroma or myxoma. I compared the x-ray with one of my own. (Pathol. No. 24646½). Dr. Baldwin's case; the involved bones were the lower end of the radius, the metacarpal and phalanges of the thumb and index finger in a boy of 12 who dated his trouble back to an injury six years before (Fig. 18).

I was inclined to believe that both were ostitis fibrosa. When Dr. Ghormley operated on the colored boy the tissue received in the laboratory was identical with Cases 1, 2 and 3, ostitis fibrosa; while when Dr. Baldwin subjected his case to operation in Salt Lake City and sent me the tissue, it proved to be a chondroma. It is true, in Dr. Baldwin's case (Fig. 18) there is some destruction of the bone shell over the lesion in the phalanx, but this has also been observed in ostitis fibrosa.

Method of Attack in Central Bone Lesions, With No Evidence of Periosteal Tumor Formation.

These cases will come under observation because of recent fracture, or contusion, or because of pain or swelling, and the x-ray will reveal a light area with more or less expansion of the bone shell. If there has been a fracture it may be incomplete or complete. There may be evidence in the x-ray of perforation or partial destruction of the bone shell. On palpation, there will be no soft-part infiltration, except in the region of the recent fracture. The bone shell is usually palpated. As a rule it is smooth. There may or may not be crepitation. I have never observed pulsation. The expansion of bone from the normal shaft from above and below may be abrupt or gradual. The markings of the light area show great differences in the same pathological types. I know of no way of making a positive diagnosis from the x-ray. I have shown here five cases in which the lesion was benign and of the type of polycystic ostitis fibrosa, and one (Fig. 18) which proved to be a multiple chondroma. In the *Journal of Radiology* for March, 1920, I have reproduced a number of examples of central bone lesions: myxosarcoma (Fig. 1); bone cysts (Figs. 2 and 5); giant-cell tumors (Figs. 4 and 6); central chondroma (Fig. 15); central sarcoma (Fig. 29); central fibrosarcoma (Fig. 18); a case then diagnosed central sarcoma, now central unhealed bone cyst (Fig. 23); central

bone cyst without connective tissue lining (Fig. 27); central solid osititis fibrosa (Figs. 32 and 39); central myxoma (Fig. 28); tuberculosis (Fig. 37).

In the *Journal of Orthopedic Surgery* [12] I have reproduced the x-rays of central chondroma and giant-cell tumors of the phalanges.

In the *Annals of Surgery* for April, 1919, [13] I published the evidence that perforation or destruction of the bone shell was not a sign of malignancy.

Since the publication in the *Journal of Radiology* for 1920 I have collected x-rays of numerous central bone lesions with pathology proved by operation. The bone cysts and giant-cell tumors predominate; chondromas, especially of the phalanges and metacarpals are quite frequent; central sarcoma is rare. The central myxomas have not been observed since my report in the *Annals of Surgery* for December, 1920, [34] and the case reported as No. 2, Pathol. No. 22929, in which the myxoma was in the center of the astragalus, has just returned under observation with metastasis to the lung.

From this accumulated experience, verified by pathological examination by a number of pathologists, I am impelled to the conclusion that the x-ray of a central bone lesion cannot be diagnosed with any degree of certainty, and that as sarcoma is possible after the age of 15, I feel it is safer to explore.

Method of Operation

If a large bone is involved, a Martin bandage should be employed; the soft parts should be carefully divided down to the bone shell; the periosteum should not be stripped back; the bone shell with its periosteal covering should be exposed at least to the size of the area pictured in the x-ray; the bone shell with its periosteum should then be divided with the electric knife and removed.

If the central tumor corresponds with that described in this paper as typical of a benign bone cyst, the fluid may be evacuated, or the connective tissue lining removed; then a fracture should be made, or the remaining bone shell crushed and the wound closed.

In all other cases it is safer to remove the tumor tissue within the bone shell with the electric cautery; then swab the wound and the exposed soft parts with pure carbolic and alcohol; then pack the wound for a few minutes with a piece of gauze wet in fifty per cent solution of chloride of zinc.

The reason for this thermal and chemical cauterization is that it is essential in the central giant-cell tumor. With simple curetting recurrences take place. It may accomplish a cure in a central sarcoma. (Bunt's case in the upper end of the humerus is well more than two years after operation). It is safer in chondroma, and it may accomplish a cure in the myxoma.

Registration of Bone Tumors by Codman of Boston

These registrations bring out the fact that the differential diagnosis between ostitis fibrosa and sarcoma and between the benign giant-cell tumor and sarcoma is difficult. If many of the best pathologists disagree after a long investigation, it would seem unfair to expect one pathologist to make a diagnosis from a frozen section in a few minutes.

This thermal and chemical cauterization in curetting the central lesion does not interfere with the ossification or healing of the cavity, and, as the chief cause of death in sarcoma of bone is metastasis to the lung, it seems a justifiable procedure to employ, because the malignant tumors, sarcoma and myxoma, are rare and difficult to recognize from the benign ostitis fibrosa, the giant-cell tumor and the chondroma.

There is no objection to placing radium in the bone cavity after operation, and to giving postoperative radiation or x-ray treatment, especially in proved or suspicious sarcoma. Many of my colleagues working with me on this subject have not as yet accepted my classification into central and periosteal lesions. From the standpoint of treatment this classification seems to me essential.

Closure of the Wound

There is no question that in the bone cyst of any type the wound should be closed. The cavity can always be partially obliterated by crushing the shell or bone transplantation. In many cases the healing has been good without either. The remarkable feature of the bone cyst is the rapid ossification after fracture or operation.

The question as to closure of the wound and bone transplantation in the benign central giant-cell tumor is yet to be settled. The ossification after curetting a giant-cell tumor is as conspicuous by its absence or latency, as it is by its presence and rapidity in the bone cyst. This is especially true in larger tumors of the long pipe bones. If the wound is left open, healing is very slow. If the wound is closed with and without bone transplantation, it usually breaks down.

The cases of central chondroma of the phalanges have all healed well after closure without bone transplantation. The central chndroma of the lower end of the femur [15] healed after curetting and radium.

The proper treatment of a central myxoma is not settled.

This question of the treatment of central bone lesions will be discussed in detail in a future paper.

X-ray and Radium Treatment

One of my colleagues interested in the radium treatment of bone lesions wrote me in November, 1920, as follows: "I hope you will soon quit operating on all these cases, now that you have them cleared up, and treat them all with x-ray or radium, which handles them satisfactorily." My personal experience does not confirm this statement.

Radiation is unnecessary in the bone cyst and ostitis fibrosa. When we can make a positive diagnosis, because the patient's age is 15 or less, operation is indicated, if there is no fracture and the x-ray shows no ossification, or the bone shell continues to expand. I have tried intensive radiation before operation in the giant-cell tumor, in the chondroma, and in the sarcoma, without apparent benefit. If one operaes on a central bone lesion in a patient over 15 years of age, in the majority of cases the lesion will be either a latent bone cyst, a giant-cell tumor, or a chondroma. All of the bone cysts and chondromas have been cured. The recurrences in the giant-cell tumors are apparently due to faulty curetting. In sarcoma and myxoma I have only one positive cure more than five years after amputation. [16] This patient is living in 1922, nine years after operation. A second case mentioned in this paper of a central sarcoma of the upper end of the humerus, operated on by Dr. Bunts in Cleveland more than two years ago, is apparently well. In this instance the operation consisted of curetting with chemical cauterization, followed by radiation, x-ray treatment and Coley serum. There is a third case, which I saw in the Mayo Clinic, which was first curetted and then amputated one year later after recurrence. The lesion was in the lower end of the femur, and the patient is free from recurrence, more than five years after amputation. It seems, therefore, justifiable, even for sarcoma, if the bone shell is intact, to attempt this method of attack.

1. Ann. Surg., 65:476, April, 1917.

2. Ann. Surg., 52:183, August, 1910.

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6. Ann. Surg., 52:183, August, 1910 (Figs. 20 and 21).
7. Bloodgood: Bone Tumors, J. Radiol., 1:147-238, March, 1920* (Pathol. No. 19179, Fig. 25).
8. Southern M. J., 16:888, December, 1920 (Figs. 6 and 7).
9. J. Radiol., 1:238, March, 1920* (Fig. 89 and its discussion, page 163).
10. J. Radiol., 1:217, March, 1920* (Fig. 19, Pathol. No. 23407).
11. J. Radiol., 1:215, March, 1920* (Figs. 13 and 14).
12. J. Orthop. Surg., 2:597, November, 1920.
13. Ann. Surg., 69:345, April, 1919.
14. Ann. Surg., 72:713, December, 1920.
15. J. Radiol., 1:216, March, 1920* (Fig. 15).
16. J. Radiol., 1:217, March, 1920* (Pathol. No. 14229, Figs. 20 and 21).
17. Arch. Surg., 4:554, May, 1922.
*—Copies available while they last, and may be obtained at the business office of the Journal.

Principles of Stereovision*

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THE perception of relief, which is furnished by the fusion of different visual impressions received by both eyes from an object in the visual field, is in a large measure a purely subjective phenomenon that permits of only relatively accurate measurement. There are numerous physiologic causes that inhibit stereognostic appreciation; such as incompensated refractive errors that make sight more pronounced in one eye as compared to the other; or strabismus, in which a fixed point in the image fails to localize in identical situations on both retinas. These inherently physiologic factors determine the subjective degree to which stereovision is sensed; and each individual presents his own stereoscopic acumen which is beyond the control of extraneous interference.

In addition to the subjectivism of stereovision, there is an objective phase which, in roentgenologic practice, must receive the most careful study if the visualization of relief is to be accomplished by physiologic imitation. The most important single item in fostering stereoscopy is the question of illumination, which involves a proper knowledge of

1. the correct intensity of illuminant;
2. the correct distribution of illuminant.

Intensity of illumination is a basic factor in stereoscopic sensing; and it must be at once realized that too great intensity, while apparently furnishing pronounced relief, in reality distorts the proper physiologic effect of stereovision. There are two main reasons for this condition, which may be experimentally elicited as follows:

First Experiment: Arrange two blackened tin boxes so as to enclose small electric bulbs such as are used on cystoscopes, and fitted with rheostat controls. Make pin hole openings in one face of each box, just opposite the bulb. Hang the two illuminators in a completely dark room so that they are aligned equidistant from an observer.

As the observer looks at the two pin points of light, an assistant alternately increases and decreases the intensity of the illumination in one of the sources by adjusting the rheostat. The observer notices that:

1. When the illumination is equal in each source, they both appear in the same plane.
2. As the illumination diminishes in one source, that source appears to recede into the background (actually, its position remains fixed).
3. As the illumination increases in one source, that source appears to approach the observer.

Second Experiment: Procure a hand stereoscope and some views usually provided therewith. Adjust a view so as to present maximum stereoscopic effect when observed in a moderately illuminated room. When this position on the stereoscope is reached, light a piece of magnesium metal ribbon; and after the brilliant glare has subsided, re-examine the stereoscopic view under the original conditions for which good relief was first obtained. It is found that the stereoscopic values have changed entirely and do not re-establish themselves for many hours.

Overstimulation of the retinal light receiving units and fatigue of optic nerve transmission are the causes.

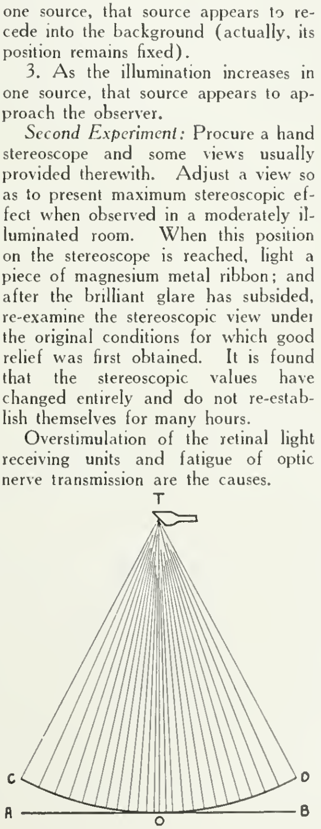

Fig. 1

From these two experiments, we find that the intensity of illumination must be correct in order to imitate physiologic stereognosis; that whereas "relief" is observed when the illumination is purposely altered, this is a spurious effect or illusion that interferes with the accurate valuation of distance perception, from which stereoscopic vision evolved. That is, it is possible to obtain illusions of relief that may be pleasing to observe (such as are purposefully sought in photoplay photography in which fictitious light values are forced in order to acquire contrast and relief); but the mere visualization of relief is not the object sought in roentgenologic practice. Here, it is desired to achieve physiologic imitation of stereovision, in order that the observed depths will represent accurately the relations of the anatomic parts under study. Beginning with the premise that roentgenologic requirements demand correct stereoscopic vision, and not simply an illusion of relief, we shall consider at this time the objective factor of illumination distribution.

An x-ray film is a flat surface upon which the x-ray radiation is projected from a point source always focused in the center of the plate. This condition is basic and follows as a prime requirement in x-ray technique; that of centralizing on the film the object to be rayed, and focusing the central ray in the middle of the object. The situation may be represented as follows: In the diagram (Fig. 1) let the line AB represent the film surface, and T the origin on the target of the radiation. The shortest distance from the point T to the line AB is, then, the central ray; and since the radiation is emitted radially in all directions, the wave front of equal radiation intensity is represented by the arc CD.

A critical study of the conditions that obtain shows that there is a single locus at the point O where the radiation is most intense; and as we recede circularly from this origin, the radiation, having travelled a longer distance and

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being influenced by the law of inverse squares, becomes proportionally less intense as the margins of the film are reached. In practice, the locus O corresponds to the center of radiographic orientation, since it is there that the most important anatomic point under examination is placed for raying.

From which we see that the distribution of x-radiation over a film surface is peculiarly arranged; and that the stereoscopic fusion of mate roentgenograms demands a distribution of illumination equivalent to the distribution of the radiation utilized in procuring the roentgenograms[1]. Any other distribution of illuminant source will furnish an illusion of relief which is wholly different from the correct stereoscopic value of the view.

Under the means at present utilized in producing stereoroentgenograms, therefore, the formula for the physiologically correct distribution of illuminant employed for visualization is definitely fixed, as shown in Figure 2, where, in the diagram, the sketch at the left represents the x-ray intensity distribution over a film; and the sketch on the right represents the correct distribution of illuminant for proper physiologic stereovision as distinguished from spurious relief.

Around this fundamental principle a new departure in stereoscopic design has led to the creation of a novel means for securing true physiologic stereovision as applied to x-ray endeavor. Aside from a mechanical design that lends itself to facility of use, the new instrument furnishes two unique assets.

First, a distribution of illumination mathematically coincident with the distribution of x-ray intensity on a plane surface. This is secured, in the stereoscope, by a centrally placed light source around which there are grouped reflecting walls of such design as to distribute the light on the opalite glass with accurate reproduction of the desired formula.

Then, a rheostat control that gradually increases or diminishes the intensity of the light until the "individual" or subjective physiologic requirement is obtained by the observer.

With this interestingly evolved instrument of accuracy[2] the elements of objective stereovision in roentgenography are perfected; and there remains only to determine the individual "subjective factor," which is accomplished in this fashion:

A wax model object, or adequate substitute, is prepared so as to contain a foreign body at a given and known depth from the surface. The model is then stereoroentgenographed and the completed films fitted into their proper view boxes. The observer then visualizes the part beginning with the lowest intensity of light (rheostat all "in"): and gradually increases the light until the point is reached when the foreign body is stereovisioned at the exact depth that it is known to be. When this is realized, the observer has found his "subjective light intensity factor"; and by keeping the rheostat fixed at that position, each subsequent examination is conducted under optimum objective and subjective conditions that favor the most accurate approach to physiologic stereovision. By this means, the illusion of stereoscopy is removed; and this form of roentgen observation becomes scientifically based furnishing thereby a sound method for the correct and rapid evaluation of anatomic relations, the ideal towards which stereoscopy has, until now, futilely striven.

Summary

(1) "Relief" and correct stereovision are not physiologically synonymous.

(2) Relief is a spurious effect. Stereovision is a true evaluation of depth based on subjective and objective factors.

(3) Stereovision is accurate in proportion as:

(a) the viewing light is distributed according to the producing x-ray intensity;

(b) the intensity of the viewing light is subjectively fitted for the observer.

(4) In response to these basic precepts, a newly evolved instrument for achieving maximum accuracy in stereovision, is discussed and portrayed.

Bibliography.

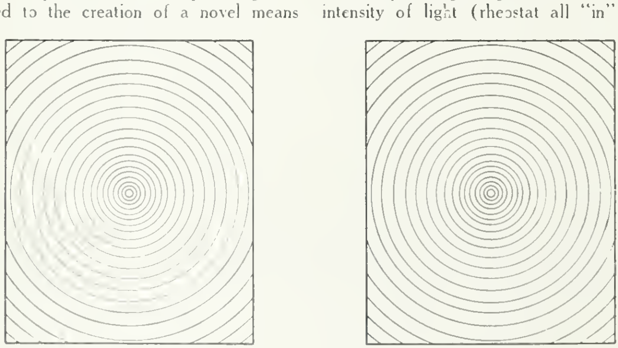
(1) *Toulouse and Pieron:* Technique de phychologie experimentale.

(2) Unpublished data from the Engineering Research Department, Victor X-Ray Corporation.

Footnotes.

(1) Review first experiment.

(2) Distinguish between precision and accuracy. A thing may be precise yet wrong. For example, a length measured with a rule that is inaccurate can be measured with precision, but not with accuracy.



A B

Fig. 2

A Summary of the Determination of X-Ray Intensities*

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AT THE annual meeting of your society in 1921 I reported the investigations I had made on the determination of x-ray intensities. These investigations were carried out for the purpose of determining a method of treatment for deeply seated carcinomata which would assure the application of x-rays of a sufficient intensity to cause degeneration or death of the cancer growth.

The constant factors used were a maximum kilovoltage of 130, determined with a sphere gap in series with the tube terminals, a milliamperage of five and a broad focus Coolidge tube of a diameter of 18 cm. The variable factors were the distances from the focus or target of the tube to the surface of the skin (designated by the abbreviation F. S. D.) the ports of entry and the filter. The F. S. D. were 35, 50, 65 and 80 cm.; the fields 5, 10, 15 and 20 cm. square, and the filters 7, 11 and 16 mm. aluminum.

*—Read at the Midyear Meeting of the Radiological Society of North America, St. Louis, May 19, 1922.

The transformer employed in these experiments was a Victor Snook with a cross arm type rectifier.

The summary of these results is shown in Tables 1, 2 and 3. The conclusions reached at the time were as follows:

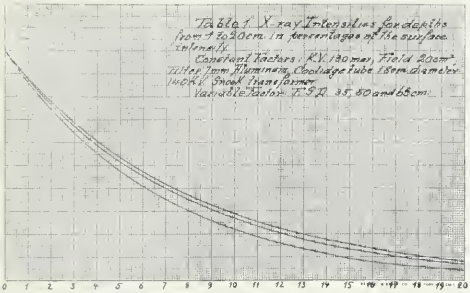
(1) Using the constant factors and a Coolidge tube of 18 cm. with a broad focus, the variable factors to obtain highest intensities are:

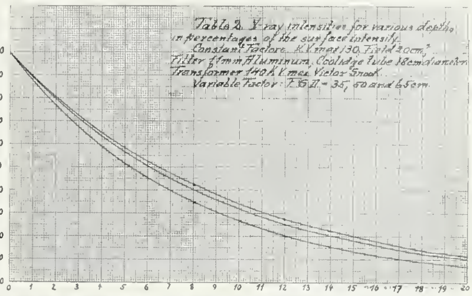
(a) With a filter of 6 mm. aluminum plus 6 mm. sole leather, an F.S.D. of 65 cm. and a port of entry of 15 cm. square, the milliampere minutes necessary to obtain an epilation skin dose (Ep. S.D.), are 500.

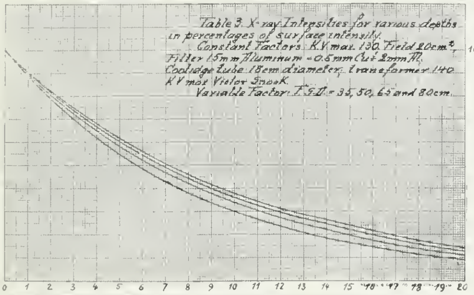
(b) With a filter of 10 mm. aluminum plus 6 mm. sole leather, an F.S.D. of 65, a field of 15 or 20 cm. square, the milliampere minutes necessary to obtain an Ep. S.D., are 750.

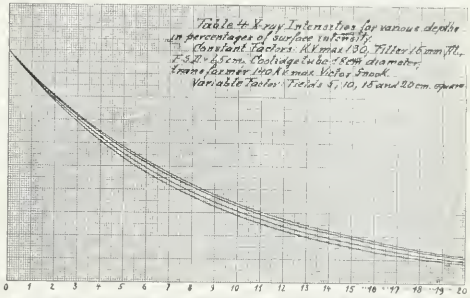
(c) With a filter of 0.5 mm. copper plus 1 mm. aluminum plus 6 mm. sole leather (equal to 15 mm. aluminum), an F.S.D. of 65 cm. and a field of 15 or 20 cm. square, the milliampere minutes to obtain an Ep. S. D. amount to 1,050.

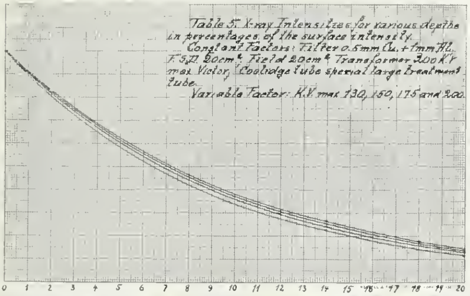
(d) With a filter of 0.75 mm. copper plus 1 mm. aluminum plus 6 mm. sole leather (equal to 20 mm. aluminum), an F.S.D. of 65 cm., and a field

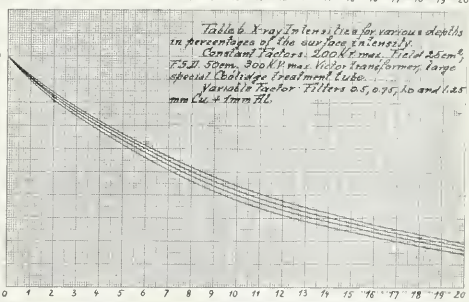


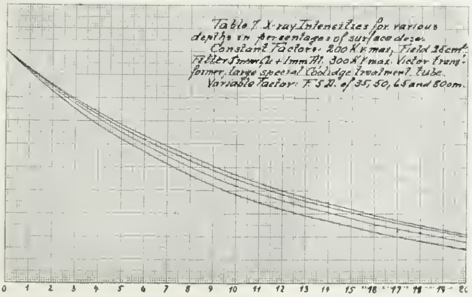


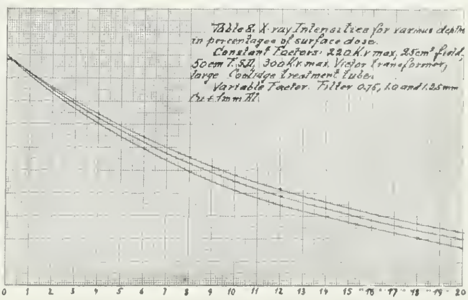












of 15 or 20 cm. square, the milliampere minutes to obtain an Ep. S. D. amount to 1,500.

2. To apply x-rays to a carcinoma of the uterus we must make transverse and median sagittal sections of the pelvis of the patient just above the symphysis pubis. The sections are obtained from exact measurements of the living subject, which must include the transverse and anteroposterior and longitudinal diameters of all anatomical landmarks as well as the seat and extent of the lesion. Figure 9 represents such a measurement. It also shows that we must use four ports of entry, an anterior field of 20 cm. sq., a posterior sacral field and two lateral fields each of 15 cm. sq. We now enter the fields in this section, fix the points 1 to 11 and then enter the intensities obtained at these points through each field. If the summation of the intensities obtained through the four fields at the points selected is above 120, then the 20 cm. sq. must be employed to obtain results.

4. It may be further inferred that x-rays obtained with factors smaller than those given will not benefit the patient. An x-ray intensity of less than 60 per cent of the epilation skin dose stimulates the cancer to proliferate more rapidly, hence renders the patient rapidly worse.

5. As to the massive doses of x-rays applied, taking into account our very high skin dose, such radiations should not be repeated before the end of twelve months if at all.

6. In the treatment of uterine carcinoma x-ray radiation is invariably combined with intrauterine insertions of radium. The equal intensity curves of 50 milligrams of radium element arranged as seen in Figure 1 and filtered with 1.5 mm. brass have been determined by Schmitz and Huth. [1] The isodoses to obtain a cancer dose at the various percentages have been ex- 5; F.S.D., 50 cm.; field, 20 to 30 centimeters square; filter, 1 mm. copper plus 1 mm. aluminum. The number of fields is two, an anterior and a posterior one. It is only necessary to determine the anteroposterior diameter. The solution of the problem is shown in Figure I. It does not require any further explanation.

The advantages gained by the newer method are:

1. Shortening of the time duration of the application of the x-rays. If 5 milliamperes are used the two field application consumes from three to four hours. The 130 kv. max. method consumes from twelve to fourteen hours.

2. The patients do not evince nearly as profound a radiation sickness with the 200 kv. max. method as with the 130 kv. max. method. Apparently the destruction of the blood corpuscles and normal tissues is less severe than with the old method.

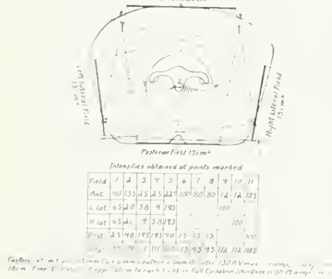


Fig. 9

Fig. 10

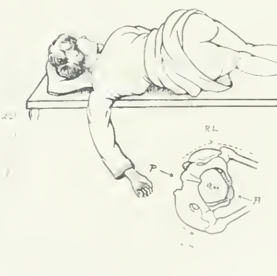


Fig. 11

time duration of application must be reduced to prevent too large an intensity at the given points, thereby preventing irreparable injuries or burns. Points 7 to 11 do really receive a small additional intensity of x-rays from the areas just external to the radiation cones. These intensities are in this instance so small that they may be neglected.

3. The results obtained from the measurements of intensities of x-rays and the studies of the topographical anatomy of the patients suffering from pelvic cancers permit the inference that with a maximum kilovoltage of 130, a Coolidge tube of 18 cm. diameter, a milliamperage of 5, a focus skin distance of 65 cm., a filter of 0.5 mm. copper, plus 1 mm. aluminum, plus 6 mm. sole leather, and a field of 15 to pressed in terms of radium milligram element hours. Entering the equal intensity curves in longitudinal median section we may determine the time duration of the application of radium. It amounts on an average from 600 to 3,600 mg. e. hrs., depending on the size of the patient.

With the collaboration of my associate, Dr. Albert Bachem, the investigations have been extended to crest kilovoltages of 150, 175, 200 and 220. Table 5 represents the results. They were obtained with a Victor 300,000 volt transformer and the large Coolidge treatment tubes. The clinical application of these results and economic considerations, that is, saving the tubes by avoiding large loads, led us to adopt the following factors: Maximum kilovoltage, 200; milliamperage,

3. The tumor is more rapidly resorbed, evidently due to the greater biologic action of the short wave x-ray. It must be assumed, though we cannot as yet prove it, that the shorter the wave length of the radiation the more intense is the biologic action on the tumor cells. The gamma rays of radium possess the shortest wave length of any radiation known. Gamma rays of radioactive substances cause a much more rapid regression of cancer tumors than any x-ray produced so far.

4. The same intensities of radiation may be closely reproduced if the same factors, that is, kilovoltage, focus skin distance, filter, size of field and tube are employed. It is, however, advisable to determine the time duration of application carefully for each transformer and for each tube.

Weight Development in White Rats as Influenced by X-Ray Exposure*

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TO THOSE of us who are employing x-ray in treatment of the hypertrophied tonsil, certain very salient questions have arisen, which may be briefly classified under two heads:

1. Have we sufficient evidence from our pioneer investigators to feel certain that the x-ray does reduce the size of the tonsil under treatment?

2. If the tonsil is markedly influenced by the ray, have we evidence to prove that other glands, such as the thyroid, are not also affected? Or, to change the question, has enough basic biologic research work been done to finally establish what good can be done in this field, and whether or not harm attends the good?

This explains the author's point of entrance into this field of research, a partial and preliminary report of which is herewith presented.

But, first, let us review the literature:

In 1921, writing on the chemical effects of alpha particles and electrons, Lind says: "It has been found that it is the physiological effects of the gamma rays which are utilized therapeutically. But whether or not the effect is produced through the intermediation of chemical action remains as yet wholly unknown."(1)

Dorsey, speaking of radium, says: "In their passage through matter, both gamma and x-rays cause high speed electrons to be ejected from a small proportion of the atoms over which they pass. These electrons are similar to beta rays; the velocity with which they are ejected depends upon the wave length of the wave causing their ejection—the shorter the wave, the higher the velocity. Those ejected by the short gamma ray waves have a very much higher velocity than those ejected by the much longer x-ray wave. One effect of both gamma and x-rays is to cause the entire mass through which they pass to be subjected to this beta ray bombardment. It is to this beta ray bombardment that the biological effect of these rays is generally attributed. (2)

Regaud, 1920, says: "Some little penetrating and therefore easily absorbed rays have a general caustic action, but the more penetrating rays have an 'elective cystcaustic action.' * * * There is a long scale of radiosensibility for animal cells, ranging between the most radiosensitive (such as certain sexual and leukocytic cells) and the least radiosensitive (such as muscular fibres and nerve cells). The radiosensibility, too, is a property of the nucleus and is inherent in certain states or temporary physiological periods of cell life, the most important and best known of which is the state of reproduction. Another period of heightened sensibility corresponds to the maximum metabolic activity of the nucleus in cells which have a secretory function. And since such cell division and nuclear metabolism are neither continuous nor prolonged states, it follows that the same cell or generation of cells manifests alternating radiosensibility and radioresistance. The effect on the cell is shown by every grade from early death to slight reparable injury. The dead cells are removed by autolysis or phagocytosis, but the intercellular substances are resistant and absorbed slowly."

Arguing from these premises, Regaud asserts that: "X-ray and gamma-radiations of very short wave length are elective poisons for nuclear chromatin, upon which, as is known, heredity depends. Hence, the rays suppress or suspend cellular reproduction in a tissue. The radiosensibility of connective tissue and lymphoid malignant new growths is as follows, the varieties of tumor being given in descending order of radiosensibility: lymphosarcoma, large and small round cell sarcomata, mixed-cell sarcoma, fibrosarcoma, chondrosarcoma, osteosarcoma."

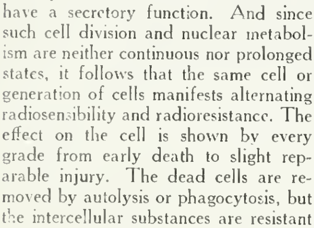

Fig. 1—General chart of litter.

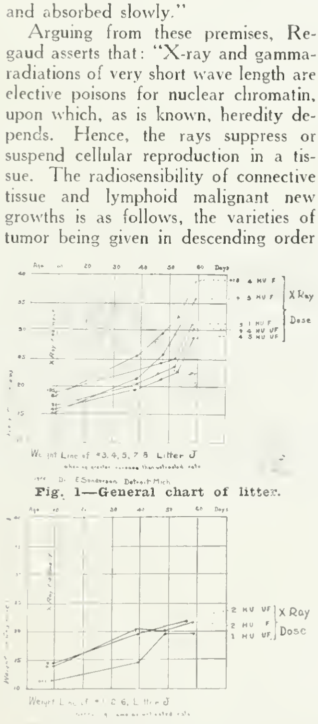

Fig. 2—Weight chart of Nos. 3, 4, 5, 7 and 8 of the litter.

Dr. Lazarus-Barlow, in commenting, says: "It is possible to doubt some of the premises and hence the conclusions, obvious or concealed, to which Dr. Regaud is conducted. Thus he repeats on at least three occasions that the action of the rays is local. No doubt in a sense this is true, but the mere facts that the intensity falls off according to the law of inverse squares, and that a circulation passes through the irradiated part, indicate that a general effect of irradiation has to be reckoned with. These distal effects of the rays may well be of great importance. Quite apart from the fact that at some distance an 'elective cystocaustic action' must become converted into an 'elective cystostimulative action,' just as at some distance an irritant induces repair, it is possible that the lymphocytic changes following on irradiation may indicate a fundamental process which is general and not local. Without wishing to be dogmatic, there is some reason for believing that patients showing little lymphocytic fall in the circulating blood upon irradiation react better to the treatment than those in whom marked fall occurs. And just as Dr. Regaud advises combined x-ray and radium treatment, so it may be combined beta and gamma x-ray treatment would give better results than either of these alone. The premise that the action of the rays is purely local has a cramping effect. Probably, too, in considering, the action of rays upon cells, attention has been riveted too much upon the nucleus. (3)

Russ, 1921, speaking of local and general action of radium and x-rays on tumor growth, says: "Prolonged exposure of the animal to the rays results in wasting and death. As the dose of radiation becomes less a stage is reached where the rate of increase of body weight exceeds that of the normal (15 per cent in 60 days)." (4)

From the Rockefeller Institute come some very valuable reports, showing that "mild doses of x-ray stimulate lymphocyte formation, and heavier doses of longer exposure, almost completely destroy both lymphoid tissue and circulating lymphocytes, without apparent damage to other tissues." (5-11)

*—Read at the Midyear Meeting of the Radiological Society of North America, St. Louis, May 20, 1922.

Dr. A. S. Warthin, Jan. 16, 1922, writes in a private communication: "Specific changes in tissues: (1) The action upon the nucleus of the lymphoid cells. (2) Skin and thyroid in the production of atypical regenerative forms of epithelium showing themselves frequently as syncytial giant cells. This action upon the regenerative ability of the tissue is, outside of the action upon the lymphoid tissues, the most striking result of irradiation in my experience." (12)

Davey, 1919, writes that "an evident prolongation of life of the Tribolium confusum is apparently due to small doses of x-rays." (13)

Mavor, working at Union College, indicates that "the most marked effects of radiation lie in the chromosomes of the cells, and possibly are most marked at the stages of cell division." (14)

In our work, the prime search was for biologic change. Reports on these changes are not yet completed, and will be presented at a later date. Starting with the very young baby rat, even exposing the embryo rat in utero to x-ray and waiting for histologic changes to occur, many marked macroscopic changes were observed: One phase of these forms the subject of this report, viz., weight development. We have had deformed rats—born without eyes, born without tails—but at this time, we will limit ourselves to one litter of eight (Fig. 1). All conditions surrounding these rats were alike for all individuals, except x-ray treatment. The rats were about ten days old at the time of exposure, hairless and still blind. One general dose was given, this being changed only in two particulars, namely, time and filter. The unit was about the Holzknecht unit and was changed by changing the time only, 3 in. spark, 3 ma., 8 inch distance, time, four minutes. Half the litter received the exposure without filter and the other half with a filter of two millimeters of aluminum, and one thickness of sole leather. The lantern slides will graphically set forth the variation in weight development of the individuals. Having weighed many untreated rats we observe that Nos. 1, 2 and 6 (Fig. 3) average about as controls. The two animals. Nos. 7 and 8, (Fig. 2) at the end of sixty days, reached the highest weight and had had the largest dose of the litter. Numbers 3, 4 and 5 (Fig. 2), arrived at a medium weight and had had a medium dose, whereas Nos. 1 and 2 (Fig. 3) showed least weight, having had the smallest dose. Number 6, grouped with 1 and 2, can only be explained by speaking of it as the omnipresent exception to the rule. In as extensive a review of literature as we have had before us, we find but one author speaking of the effect of radiation on the weight of white rats. Russ writes: "The prolonged exposure of the animal to the rays results in wasting and death. As the dose of radiation becomes less, a stage is reached where the rate of increase of body weight exceeds that of the normal (15 per cent in 60 days)." In this series it would not appear that we had given a harmful or withering dose to any individual, though from other series we do know that such an effect can be produced.

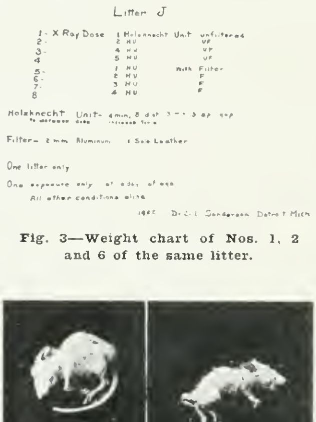

Fig. 3—Weight chart of Nos. 1, 2 and 6 of the same litter.

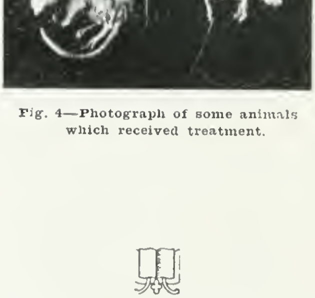

Fig. 4—Photograph of some animals which received treatment.

It does, therefore, seem feasible to assume that a gradation of dose exists which, in respect to body development, varies in results, from ineffective, through stimulating, up to destructive results. How this is accomplished, what part the endocrine glands play, how we can use alpha and beta rays, how we can use gamma rays, whether x-ray and gamma rays are ineffectual in themselves and whether they become effectual only when transmuted into beta-ray bombardment are all problems forming a fascinating subject, upon which much thought and study can be expended and ultimate findings are still for future research.

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The Problem of High Potential Measurement as Associated with Deep Therapy at High Voltages*

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San Francisco, California

THERE are two obvious means of standardizing x-ray measurements, to enable accurate repetition of dosage with the same apparatus, or to permit the results of one investigation to be applied by another with a different apparatus.

The first of these means is to measure the x-rays emitted from the tube, and to use this measure as a basis of comparison. While this seems the most logical system, the apparatus for accomplishing it has not yet been developed to a point where it has wide practical utility, and we are forced to continue the use of the second type of readings.

These, in brief, constitute an attempt to predict what comes out of the tube, in the form of x-rays, from a statement of what we are putting into the tube, in the form of electrical energy. In doing this, we have customarily measured two electrical quantities—current, with the milliammeter, and voltage, with the kilovolt meter, or with a spark gap.

We have then assumed that, if we obtained a certain result when operating one machine at a given milliamperage and spark gap, we would get a sufficiently accurate duplication of this result on a different machine, if only we set for the same milliamperage at the same gap.

This is only comparatively true, however. At the lower spark gaps, such as are used for radiography, it will serve fairly well. At the higher gaps, such as are generally used in therapy, certain discrepancies begin to appear, while at the very high voltages now being used for deep therapy, there is every reason to expect greater discrepancies. We would most certainly not rely too heavily upon a spark gap (or even sphere gap) readings as an index of the performance of all types of high voltage x-ray apparatus under all conditions, until the accuracy of the method is supported by better evidence than we have at present.

In order to illustrate this source of error most readily, let us imagine a slow moving picture showing graphically the rotation of the rectifier member in an x-ray machine, with the resultant increase and decrease of voltage and current applied to the x-ray tube during a single pulse or alteration. Further, suppose we are using high voltage and heavily filtered rays, and that our picture also shows graphically the nature of this x-ray pulse.

Beginning at the point where the voltage from the transformer is zero, we find that the rectifier is in such a position that the circuit is open and no current flows. Hence, no x-rays are produced.

Now, as the voltage rises, and the rectifier rotates, we eventually reach a point where a spark passes, a current flows and x-rays are produced. However, with the average rectifier, this current begins to pass long before the voltage has reached its maximum; and with heavy filtration, rays produced much below the maximum voltage do not pass through the filter in any great quantity. Therefore, it is not until the voltage ever, rises to its saturation value also useful radiation is obtained.

The current through the tube, however, rises to its saturation valve almost as soon as the circuit is established, and remains at this value as long as the pulse continues. That is to say, there is no gradual increase and decrease of current as we pass from lower to higher voltages and back, and therefore, if we observe an increasing and decreasing pulse of filtered rays during the cycle, we should ascribe it solely to the change in voltage—since the current has remained substantially constant.

To return to the voltage—as this factor increases, the rays produced become more penetrative and hence, more and more of them pass through the filter in the form of useful radiation, until, when the voltage in the pulse has reached a maximum, a maximum of filtered rays is being delivered. Naturally, as the voltage in the pulse decreases, the radiation falls off correspondingly

We have thus produced during a single electrical pulse, a pulse of filtered x-rays containing a certain total quantity of radiation, a fraction of a dose. The exact amount of radiant energy in this pulse depends upon the following three factors:

(1) The transmitting characteristics of the filter.
(2) The average current in milliamperes.
(3) The applied voltage.

*—Read at Midyear Meeting of the Radiological Society of North America. St. Louis, May 20, 1920.

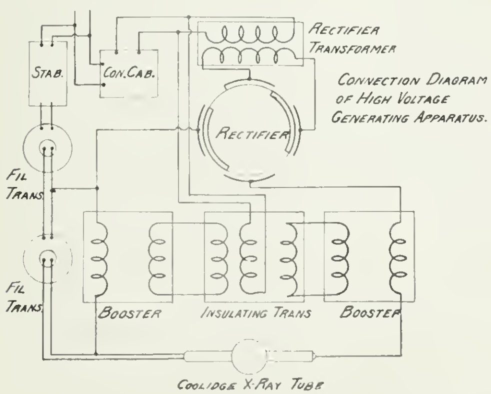
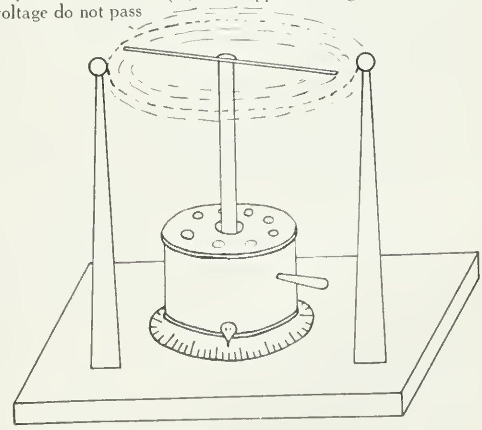


Fig. 1


SYNCHRONOUS CONTACTOR
Fig. 2

We can easily duplicate the filtration accurately by using a filter of like material and like thickness. We can likewise duplicate the current factor accurately by a return to the same average milliamperage, especially since the saturation characteristic of the Coolidge tube gives us an almost uniform current during the entire pulse. But the voltage factor is not so easily duplicated.

As we have seen, x-rays only begin to pass through the filter when the voltage gets high, they increase when it gets higher, and they persist only as long as it stays high. Thus, in estimating filtered x-rays, what we really want to know is how high the voltage gets and how long it stays high.

Now, let us consider the various means of measurement in common use and see how well they enable us to answer this question.

First in order comes the voltmeter, variously termed kilovoltmeter and spark meter, and connected either in the primary circuit of the transformer or in a special secondary circuit.

This instrument gives a reading proportionate to the average effect of the entire voltage pulse, making no allowance for the fact that only the higher portion of this voltage pulse is passed on the tube through the rectifier, and only the very highest portions produce appreciable filtered x-rays.

A slight change in wave form, resulting in a small percentage increase or decrease in the crest value, will, therefore, produce no great change in the total effective potential, although it may vary the emission of filtered x-rays by several hundred per cent.

This readily explains the known inaccuracy of the voltmeter for x-ray purposes, since the wave forms on different machines may differ widely, and the wave form on the same machine may be made to change through a considerable range by changing circuit conditions, for example, changing from rheostat to auto-transformer control. A voltmeter has, however, the advantage that it may be read continually during operation and changes in line voltage may be thus detected and compensated for. It also has the advantage that a return to the same setting and the same milliammeter and voltmeter readings on the same machine should permit a reasonably accurate duplication of results.

Now, let us consider the spark gap and more particularly the sphere gap, since this form has been widely advocated for the measurement of the very high potentials used in therapy.

The sphere gap is free from many of the vagaries of the point gap and will consistently register the maximum voltage. Only one correction need be applied for accurate work, the one for variations of barometric pressure due to altitude. And it can be duplicated accurately in construction, one sphere gap will read exactly the same as another of the same size, which was far from true with point gaps.

But, any spark gap only tells us how high the voltage got—and that is only half of our question. The other, and equally important half, "How long does the voltage stay high?" is not indicated at all by spark gap readings.

To illustrate, let us say we are producing filtered rays, and we set a sphere gap for two hundred kilovolts and then gradually increase the output of our apparatus until the gap flashes over.

All we have found out is that at some point one of the voltage pulses applied to the tube reached a voltage of two hundred kilovolts. We have not the least idea whether it stayed at or near that value for five thousandths of a second, or one thousandth of a second, or even one ten-thousandth of a second. The sphere gap would have flashed with equal readness.

And yet a high voltage crest lasting five thousandths of a second would cause five times the quantity of filtered x-rays to pass that would be caused by a pulse lasting one-thousandth of a second, and fifty times as many such rays as would be generated by the pulse of one ten-thousandth second.

So we come to the conclusion that we can only trust sphere gap readings as an index of filtered x-ray emission if we can be sure that all x-ray machines, under all conditions, produce voltage pulses that stay at a higher value for the same proportionate portion of a cycle.

This seems rather a fragile basis on which to rest so important matter as dosage standardization, especially in the light of the following well established characteristics of the sphere gap.

This device was originally developed for the measurement of alternating potentials, and was found to give consistent readings corresponding to the maximum or crest potentials. However, it was soon found that if sparking or even heavy brush discharge was permitted in the circuit containing the sphere gap, surges were thereby excited and the readings could no longer be depended upon to correspond to the truer crest values of the alternating potentials. As a consequence, one of the precautions widely recognized in the use of the sphere gap on alternating circuits is that no sparking or brush discharge be permitted in the gap circuit.

So much for the engineering use of this instrument. Now comes the x-ray art and appropriates the sphere gap bodily for use in circuits where there is always a large amount of sparking and brushing. We should naturally expect errors to result. And when we consider that the higher the potential, the greater the surge tendency, we are justified in looking rather dubiously at the sphere gap as a standard for high voltage deep therapy, at least, until we have more experimental evidence.

The following brief account of work done by the writer may serve to supplement the work of others along these lines and to promote further discussion and investigation. This work includes the following points, briefly tabulated:

(1) The development of a high voltage x-ray circuit which would minimize the surges delivered to the tube.
(2) Tests of the sphere gap as a measuring instrument in such a circuit to determine the voltage limits for consistent readings.
(3) Development of an apparatus for determining by absolute measurements the maximum potential and the wave form in a high voltage circuit.
(4) Readings taken with this apparatus on the new circuit, with a chart of typical wave form.

Surges which originate in an x-ray machine and are transmitted to the tube circuit are caused by the sudden release of electrical energy from a circuit under stress, when the rectifier has rotated to a point where the current can jump from the moving to the stationary members and complete the circuit.

The sudden starting or stopping of an electric current causes temporary abrupt rises in potential, whose effect may be roughly compared to the jarring effect produced in a water pipe when a full flow of water from the tap is abruptly shut off.

These electrical surges may be prevented from reaching the tube circuit by interposing resistances or choke coils, and a tube circuit thus freed from the influences of surges should permit of much more accurate measurements of voltage.

However, stopping surges by resistance or choke coils would result in a certain drop in voltage between the transformer and the tube, which is not desirable. The circuit shown in Figure 1, however, has the advantage of preventing the surges from reaching the tube circuit, and at the same time has no voltage drop. Briefly, this arrangement consists in adding to an x-ray transformer and rectifier a pair of supplementary transformers, one of which is inserted in each of the wires leading from the x-ray machine to the tube.

These supplementary transformers are arranged so that the sum of the voltage contributed by them to the circuit is identical with the voltage furnished by the x-ray machine.

Thus, with this arrangement, an x-ray machine capable of furnishing 150,000 volts crest potential, may have added to its output an additional 150,000 volts crest potential, making a total potential applied to the tube of 300,000 volts.

Using this apparatus, tests were made to determine its adaptability to operating the large Coolidge tubes for deep therapy, and to determine, if possible, the safe voltage limits of operation for such tubes.

Starting at 200,000 volts, the voltage of the apparatus was gradually increased, and maintained for a considerable time at each new value in order to determine the performance of the tube.

The crest potential readings with a sphere gap were frequently repeated at each value of applied voltage and from the consistent repetition, or lack of it, in such readings, an attempt was made to discover whether surges were present in the circuit.

At the 200,000 volt limit, the tubes operated with almost suspicious smoothness, and the sphere gap readings could be repeated as often as desired with absolute accuracy.

As the potential was increased, a point was finally reached where two things happened. First, the sphere gap readings began to show wide irregularities for the same applied primary voltage. Although the filament current and the milliamperage were kept constant by means of a stabilizer, and no other variations were observed in the circuit, the sphere gap readings taken in succession would vary by as much as fifteen per cent.

The second phenomenon which made its appearance simultaneously with the irregular sphere gap reading, was an electric discharge from the anode terminal of the tube, extending out over the stem and the bowl. This discharge at first showed itself in the form of small snapping sparks, rapidly repeated, and as the voltage became somewhat higher, it assumed the form of an almost continuous fluttering blue brush discharge, giving a soft, tearing sound and punctuated occasionally by bright snapping flashes to some part of the bowl.

This condition was very probably caused by an accumulation of a negative electric charge on the inside of the bowl of the tube, with a consequent darting out of a positive charge from the anode to neutralize it.

This condition of irregular discharge immediately generated surges in the circuit, the irregular effects of which were reflected in discrepancies in the sphere gap radings.

Not all tubes reached this critical condition at the same potential. A tube which has not been well evacuated, or subsequently "seasoned" by speedy operation at a lower voltage, will act in this irregular manner at a comparatively low voltage, possibly only slightly in excess of 200,000 volts.

On the other hand, a well pumped and "well seasoned" tube behaves surprisingly well on this circuit. We found it possible to operate some tubes as high as 275,000 volts and for extended periods without any irregularities.

An attempt was next made to determine the wave form or shape of the electrical pulse delivered from this apparatus to the tube. For this purpose, a rotary contact arm driven by a synchronous motor was so arranged that current from the high voltage line could be led through it to an instrument for measuring voltage.

Figure 2 shows this contact arm, illustrating also the means by which the synchronous motor may be rotated on its mounting so that contact is made at any desired portion of the wave.

Figure 3 shows this contact arm in use in conjunction with a kilovolt balance—an instrument for weighing the electrostating attraction between two opposed plates of known area. If suitable precautions are employed it is possible to compute from the dimensions and construction of such an instrument the absolute value of the voltage charge. It was desired in these experiments to compare this absolute value with the crest value of potential as shown by the sphere gap.

Figure 4 illustrates a typical potential curve taken with this apparatus on the circuit just described. The crest voltage as shown by the kilovolt balance was 240,000 volts, while the sphere gaps indicated an average of 243,000 volts. A well seasoned tube was used in this experiment, and consistent repetition of the sphere gap readings was, therefore, possible.

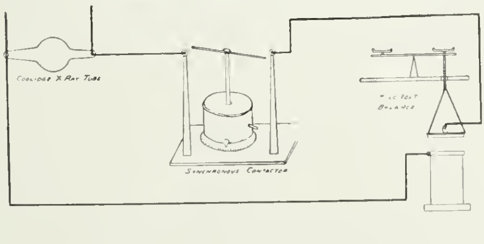
Summary

(1) Standardization of x-ray work in terms of the electrical energy put into the tube is not possible unless the wave form of the exciting apparatus is known, in addition to the crest kilovolts and the milliamperes.

(2) A circuit is described which suppresses surges due to the operation of the rectifier. With this circuit and a well seasoned tube, consistent operation is possible at somewhat higher than the usual voltages. The limit to such operation is reached when surges are generated by the x-ray tube itself. It seems probable that the limit of operation of the ordinary form of apparatus employing a transformer and rectifier may be partly due to surges from the apparatus, and also partly due to the enhancing effect of the x-ray tube upon such surges.

(3) An experimental apparatus is described which makes possible the investigation of the entire range of wave form from any x-ray machine. Wider investigations with this instrument should enable us to determine accurately and easily the difference, if any, between the wave forms of commonly used x-ray machines and in the light of these differences, standardization can be more intelligently affected.

(4) It seems possible to develop from this experimental wave tracer an instrument for continuous use in x-ray plates to replace the sphere gap as a means for measuring input energy.



Apparatus for Tracing Voltage Curve
Fig. 3

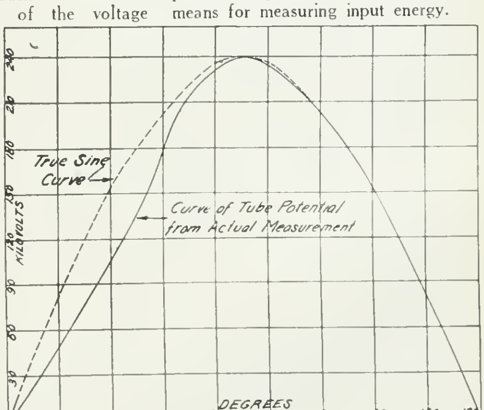


Fig. 4

EDITORIAL

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Annual Meeting

THE UNIVERSAL feeling of all those in attendance at the annual meeting at Detroit in December was that this was one of the most profitable meetings ever held by the Radiological Society. The attendance was large and the program was exceptional. Only one criticism could possibly have been made of the program and that was that there were too many papers. This number allowed no time for discussion in many instances.

There were two papers on the program which called forth many comments. One was by Dr. Lewis Gregory Cole on the examination of the cervical spine and the other was by Dr. Amedee Granger on examination of the sinuses. Both of these papers will appear in an early number of the Journal.

The commercial exhibit was large and was unusually well attended by those at the meeting. The commercial men expressed themselves as highly pleased with the arrangement provided for them.

The committee on local arrangements deserves great credit for providing for the scientific sessions, the social functions and for the scientific exhibit in the way in which they did. The scientific exhibit was unusually interesting and was constantly attended.

Gold Medals

FOLLOWING the usual custom of the Radiological Society gold medals were awarded to four who have rendered some conspicuous service to the science of radiology. This year gold medals were awarded to Maud Slye, Ph. D., Chicago; Dr. Percy Brown, Madison, Wisconsin; Madame Marie Curie, Ph. D., Paris, France, and Dr. Gosta Forsell, Stockholm, Sweden.

Honorary Degrees

IT IS the custom of the Radiological Society to annually confer the honorary degree upon two members of the society who have rendered outstanding service to the profession. This year the degree was conferred upon Dr. Francis H. Williams of Boston and Dr. Francis Carter Wood of New York City. Sketch of the work of these two men is found following.

FRANCIS HENRY WILLIAMS, M. D.

FRANCIS HENRY WILLIAMS, one of the distinguished sons of Massachusetts, was born in Uxbridge of that state in 1852.

At the age of twenty-one years he graduated from the Massachusetts Institute of Technology and in the following year he went to Japan as a member of the U. S. Transit of Venus Expedition. During the next year he completed the tour of the world thus begun, and returning home entered Harvard Medical School, from which he was graduated in 1877. The next two years were spent in European study, and since 1879 he has practiced medicine in the city of Boston, where he has held various positions of merit and honor. During the great war he was a member of the Volunteer Medical Reserve Corps, and he also devoted much time to experiments connected with methods of detecting submarines.

From 1879 to 1883 he was Dispensary Physician at Harvard Medical School, where he taught materia medica and general therapeutics, and where he developed the method of giving bedside instruction in the wards to small groups of students. From 1883 to 1913 he was Physician to the Out-Patient Department, Assistant Visiting Physician, and Visiting Physician of the Boston City Hospital. In 1913 he became Senior Physician of that institution.

It was Dr. Williams who introduced into Boston in 1892 the practice of making bacteriological examinations of the throats of diphtheria patients and who in 1894 introduced the use of diphtheria antitoxin in that city.

Early in 1896 he began using x-ray examinations with a view to their employment in the diagnosis of pulmonary tuberculosis. These first examinations were made in the Rogers Laboratory of Physics of the Massachusetts Institute of Technology. In April, 1896, he published in the Boston Medical and Surgical Journal "A Note on X-rays." In May of that year the x-ray department of the Boston City Hospital was unofficially established through Dr. Williams' influence, he at this time doing all the work and providing the necessary apparatus and materials. In 1912 he instituted here the practice of precautionary x-ray examination of the chest. In 1915 he resigned as Chief of the X-ray Department, but continues to hold his position as Visiting Physician.

In 1900, at the suggestion of Dr. William Rollins of Boston, Dr. Williams first used radium, and in 1903 used pure radium bromide in the treatment of epitheliomas and some other skin diseases at the Boston City Hospital. His first article upon the treatment of tonsils with radium was published in March, 1921, and this was followed by the presentation of this subject before different medical societies in 1921 and 1922, and the publication of a further article in the Boston Medical and Surgical Journal, September 14, 1922.

Dr. Williams is a member of the Union Boat Club and of the Harvard Club of Boston, also of the Technology Club and the Century Club of New York City. He has been a member of the Corporation of Massachusetts Institute of Technology since 1882 and was a member of the executive committee of that corporation during the first twenty-five years of its existence.

He is a member of the Massachusetts Medical Society, the American Medical Association, the Society for Pharmacology and Experimental Therapeutics, and the Association of American Physicians, of which he was president in 1918. He is a Fellow of the American Academy of Arts and Sciences, a member of the American Association for the Advancement of Science, a member of the Societe de Radiologie Medicale de France, and corresponding member of the K. K. Gesellschaft der Aerzte in Wien. He is an

honorary member of the American Roentgen Ray Society and of the American Radium Society.

Dr. Williams, besides his many contributions to current medical literature, is the author of "The Roentgen Rays in Medicine and Surgery" of which three editions have been published. Following is a bibliography of his writings, published and unpublished:

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FRANCIS CARTER WOOD, B.S., M.D.

DURING the past few years Dr. Wood has devoted a large part of his attention and study to the problem of the biological action of radium and of x-rays on isolated tissues and on tumors, and in collaboration with his assistants has published several papers which report his findings.

One of the most important results of this study has been the determination of the lethal dose of radium and of x-ray for the cells of animal tumors. (Wood, F. C., and Prime, F. The action of radium on transplanted tumors of animals. Annals of Surgery, 62:751, 1915. Lethal dose of roentgen rays for cancer cells. Journal of the American Medical Association, 74:308, 1920.) In this work a mouse tumor has been used (Crocker Fund No. 180), and it has been suggested by Dr. Wood that this tumor, because of its constant and tested biological qualities, be used as a standard for the calibration of x-ray machines and ionization apparatus, so that each operator may control the workings of his machine exactly. The use of this tumor as a standard will also make possible a biological comparison between the action of x-ray and that of radium and permit the estimation of equivalent dosage. Crocker Fund tumor No. 180 has already been distributed from the Crocker Laboratory to a number of institutions throughout the United States and Europe and is available to any workers who desire it.

Under Dr. Wood's direction there was installed this year at St. Luke's Hospital, New York, a high power x-ray plant for the treatment of patients, and there is now at the Crocker laboratory, also under his direction, an x-ray machine designed to deliver 200,000 volts direct current.

There have been carried out in the laboratory by members of the staff, all under Dr. Wood's direction, important series of studies on immunity in its relation to cancer, and by one of these it has been definitely shown that the theory that immunity might be induced by the stimulation of lymphocytes by the x-ray was not well founded.

By another long series of experiments carried out in the laboratory it was proved that the incision of a tumor and the removal of a small fragment for microscopical study does not result in the distribution of the tumor cells, as has been asserted, and is an entirely justifiable procedure when diagnosis can not be made by other means. (Wood, F. C., Diagnostic incision of tumors. Journal of the American Medical Association, 73:764, 1919).

On the other hand, other experiments have proved that gentle massage of transplanted tumors results in a great increase in the number of metastases, which indicates the danger of palpating or handling a human tumor before its removal.

Extremely interesting and suggestive experiments have been continued on the artificial production of cancer in rats. It has been observed that the offspring of rats which have developed cancer under irritation show a much greater susceptibility to such irritation than their parents, as far as one strain is concerned. In another strain of animals which are outwardly exactly similar to the susceptible ones, few tumors ever appear, though the irritation applied is quantitatively exactly the same, and what is more strange, if no irritation is applied these animals never develop cancer. Hence, Dr. Wood questions whether cancer is hereditary, as has often been assumed, but believes rather that there may be transmitted under suitable conditions a sensibility of the tissues to irritation. If sufficient irritation is then given cancer will be produced, if the tissues are not irritated the animal remains in health. These experiments, however, should not be considered as suggesting the probability that such extreme sensibility of tissues occurs in human beings. For this highly sensitized condition in animals is only obtained by most intense concentration of susceptible strains, a thing which never could occur in man. Neither can the results of such experiments on animals be considered as absolutely transferable to human beings.

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A Course in Physiotherapy

A SECOND course in Physiotherapy will be given at Walter Reed General Hospital, Washington, D. C., beginning February 27, 1923, and continuing for a period of four months. It is open to women who have had at least two years of training in an approved school of Physical Education. For further information, apply to: The Commanding Officer, Walter Reed General Hospital, Washington, D. C., att. Department of Physiotherapy.

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Acme-International Treatment Tube Stand

THE NEW ACME-International Treatment Tube Stand combines maximum flexibility with a minimum amount of adjusting mechanism and eliminates all friction points.

The tube stand is mounted on a base of heavy iron, giving a substantial rigidity to the entire unit. The upright column is high enough to assure the operator sufficient range in the vertical plane, and within this column is the counterweight for perfectly balancing the weight of the tube shield supporting arm and shield proper. The counterweight is attached to a ball bearing vertical collar by means of a specially tested cable operating on a ball bearing swivel head pulley.

Two locking handles control all movements of the tube shield supporting arm. One of these is attached to the collar, which locks the entire tube head unit at any desired height.

The other locking handle controls all movements of the shield head. A slight turn of this handle, which is of exactly the proper size and shape to enable the operator to secure a firm grip, locks the head at the desired angle. The grip handle on the outer edge of the shield head, serves as a means for conveniently manipulating the angle of the x-ray beam.

The locking handle controls a universal joint designed with a series of corrugated surfaces which prevent slipping of the shield head.

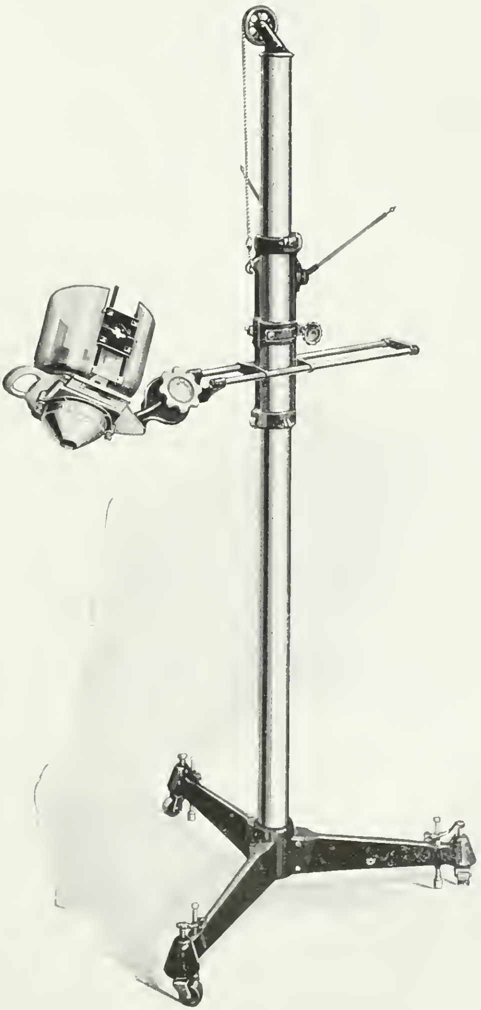
An open type lead glass bowl for a tube with seven-inch diameter bulb is normally furnished. A closed type shield of this size can also be furnished, where better protection is demanded. An open type shield suitable for an eight-inch diameter bulb tube can be furnished, but is not recommended when over 170 crest kilovolts are used.

The filter slot is so designed that filters can be inserted from either side and in any number up to six millimeters in thickness. The filters are held in place by spring pressure. This same spring pressure serves as a means of holding the cone firmly in place. A slight turn to either the right or the left will insert or remove the cone, but at the same time the special construction of the cone and the spring pressure prevent the cone becoming loosened by vibration.

Three sizes of cones are available and an opening of $3/4$ inch, $1\frac{1}{4}$ inch or $1\frac{3}{4}$ inch can be secured by simply changing the entire cone without any loosening of screws or clamps. There are also two sizes of cylindrical cones procurable if the technique demands these.

The tube stand is equipped with easy moving casters and can be readily moved to any desired position and then locked to the floor by floor stops on each leg of the tripod base.

The finish of the entire unit is of black enameled and polished aluminum and nickel of the usual Acme-International quality.



The Engeln New Steel Film Filing Cabinet

THE ENGELN Electric Company has recently put on the market a new accessory designed to increase the efficiency of every x-ray laboratory, a steel film filing cabinet which solves the problem of keeping x-ray films in a convenient place for immediate reference and filing.

One of the special features of this cabinet is the small two inch drawer at the top of the cabinet, which has been termed a temporary drawer. The advantage of this small drawer is obvious—exposed films are readily accessible for reference during the day as well as serving as a convenient receptacle for the entire day's exposures. The filing can thus be quickly done either at the close or the beginning of the day.

The rest of the cabinet is made up of three large drawers, which are of sufficient size to accommodate all films, including the 14 by 17 size. The films may be filed on edge in the same manner as correspondence in an ordinary letter file.

This manner of filing makes the films very accessible with a capacity of approximately 5,000 films in the cabinet when folders are not used. If the filing system is arranged to use folders with ordinary index guides, the Engeln steel film filing cabinet will accommodate approximately 2,500 films.

Each large drawer is equipped with roller bearing suspension so that the drawer moves freely and easily. The suspension guides move in a ratio of two to one when the drawer is open, so that the filing drawer is securely held when fully extended. This action braces the open drawer against all weight and strain.

The mechanical construction of these files is the very best that can be obtained. The cabinet is welded throughout, eliminating the usual bolt and rivet found on inferior types of cabinets. The back is solid and welded into place. The large drawers are interchangeable and may be removed easily by slightly raising the drawer. The cabinets are finished in olive green enamel and the handles and ticket holders are pressed from solid bronze and given a satin finish. The overall dimensions of the cabinet are 20⅛ by 26 1/16 by 56⅜. Each filing drawer has a clear filing space of 17½ by 4¾ by 24 inches.

The efficiency and value of this system of filing films is obvious when one realizes what such loss would mean in inconvenience and irreplacability. Its general appearance is attractive.

The standard steel film filing cabinet comes without lock, but the Engeln Company will be glad to furnish these cabinets with a special four drawer, automatic lock, of the "push button type" and designed so that all drawers will lock independently of each other when tightly closed.

ABSTRACTS *and* REVIEWS

Appositional Growth in Crown-Gall Tumors and in Cancers. Erwin F. Smith, Sc.D., *Chief of the Laboratory of Plant Pathology, Bureau of Plant Industry, United States Dept. of Agriculture, Washington, D. C.* J. Cancer Research, 7:1, January, 1922.

A PLANT tumor was induced in a young tobacco plant by introducing the Paris daisy strain of Bacterium tumefaciens. Later examination of sections of the plant tumor so induced revealed "what cancer specialists have called conversion of normal cells into tumor cells by apposition, that is, by contact of the diseased with the normal, the 'shoal' proving to be a 0.5 mm. wide layer of cells intermediate in character between the normal cortex-cells and the tumor-cells." In this type of tumor growth there is continual "peripheral extension of the tumor farther and farther into the cortex by conversion of the adjacent normal cortex-cells into tumor-cells. One cortex-cell may give rise to a hundred or more tumor-cells."

Twenty-eight plates portray the histology of this particular tumor.

A large part of the original paper is taken up with a review of the literature of Ribbert, Borst, Virchow, Hansemann, Hauser, Krompecher, Peterson, Mentrier and others as it pertains to theories on the origin of cancer.

"What resemblance, if any, the phenomena here described may have to peripheral growth in animal and human cancer must be left for the oconologists to determine. As we have seen from the statements cited in the first part of this paper, students of cancer are poles apart in their views as to how primary cancer grows in tissues of its own type, but it will be observed that there is a wide difference in the value of the two kinds of statements, since the one kind are affirmations based on observations, while the other are denials based on inability to see. * * * In this connection it might be well to remember that when a man approaches a problem with a preconceived notion he is often blind to the plainest phenomena. Every experimenter knows this from his own observation and not infrequently from his own experience. One of the important things to be settled, it would seem, is whether anything like what I have here described occurs in human cancer. Hauser, Hansemann, et al., say it does; Ribbert, Borst, et al., say it does not. If it does occur, then it is one of the strongest evidences pointing toward parasitism, and it does not need to occur always to be important, nor need it be in any way confused with invasion, which is the entrance of the cancer cells into tissues of other types where in general no claim is made that there is any growth by apposition."

Cancer of the Mouth. Joseph C. Bloodgood, M.D., Northwest Med., 21:280, September, 1922.

ORAL hygiene and proper care of the teeth are the great preventives of cancer of the mouth.

The author advocates early surgical removal, and though there is always room for doubt regarding the ultimate outcome, he believes that there will seldom be any recurrence if the operation is done properly and early in the history of the case. The glands should be removed if the lesion is carcinomatous. He would not use radiotherapy alone in the early cases, but advocates its use in conjunction with surgery. He says of radiotherapy that "the chapter on the use of radium and x-ray in the glands of the neck can not yet be written upon facts, only upon hope, but it seems to be that a chapter on the attitude toward a lesion on the lower lip has been written and is conclusive."

Far advanced cases are usually hopeless, only a ten per cent cure can be claimed for surgery in these cases, and the author advocates radiotherapy for these.

Cancer of the Tongue. William Seaman Bainbridge, M.D., J.A.M.A., 79:1480, October 28, 1922.

INACCURATE diagnosis is many times responsible for fatal neglect of carcinoma of the tongue and just as often leads to wrong treatment, e. g., syphilitic lesions have been sometimes diagnosed as cancerous lesions. The most painstaking and capable pathologist is sometims apt to be in error, and careful correlation of methods of diagnosis is necessary in arriving at the truth.

Except to advise radiotherapy as a palliative in hopeless cases, no direct statement is made regarding it, although the writer in his case report cites two instances where the severity of the case increased after x-ray therapy had been employed and thus indirectly he discountenances its use in these lesions.

X-ray Examination of Mastoids. Floyd D. Rogers, M.D., J. S. Carolina M. A., 18:309, October, 1922.

THE x-ray is useful not only to determine whether the mastoid is involved in suspicious cases, but to determine the distribution and arrangement of mastoid cells, which will be found to differ not only in different individuals, but on the two sides of the same individual.

"The roentgenologist can answer very accurately the following questions: position of the lateral sinus; the size and shape of the mastoid; whether the mastoid is completely sclerosed, or whether the sclerosis is evident only about the canal with open cells posteriorly; whether one mastoid is sclerosed and the other normal; the amount of destructon of cellular structure; and in acute conditions whether or not the mastoid is hyperemic."

The Roentgen Ray in Tonsillar Disease. Francis L. Lederer, M D., J.A.M.A., 79:1130, September 30, 1922.

A FAIR trial of roentgen ray treatment of tonsillar disease is being attempted in this author's clinic. The treatment is being carried out entirely by experts.

So far no very marked effects of treatment have been observed, but an exhaustive report is being contemplated after sufficient data have been gathered.

Carcinoma of the Larynx Treated Locally with Radium Emanation. Otto T. Freer, M.D., J.A.M.A., 79:1602, November 4, 1922.

THE nature of radium emanation is briefly discussed and "curie" and "millicurie" defined. The method of collecting the emanation is briefly described and there is described an apparatus, perfected by the author, for intralaryngeal radiation by radium emanation. The technique of treatment is also given.

Results of treatment and prognosis are discussed and this is followed by a clinical report upon 32 cases of the larynx treated according to the author's method. He says: "My experience has confirmed my opinion that emanation irradiation used as described is the best existing treatment for carcinoma of the larynx; in spite of possible recurrences. The successful re-irradiation of recurrent growths has made the outlook in regard to them unexpectedly favorable."

A Preliminary Report on the Treatment of Carcinoma of the Esophagus with Colloidal Selenium. Elmer E. Freeman, M.D., Boston M. & S. J., 187:727, November 23, 1922.

IN HIS discussion of diagnostic methods the author says that clinical history, physical examination and special methods must all be utilized in conjunction with the x-ray, although "a careful x-ray study offers more in the way of diagnosis than does any other method of examination." To this statement he adds, however, that x-ray examination cannot replace endoscopy, and in spasm of the upper or lower end of the esophagus the latter is the most useful method.

The only technical point mentioned in direct connection with the x-ray examination is that the esophagus must be empty of food before the x-ray examination, else a patulous condition may lead to a diagnosis of obstruction.

X-ray Treatment of Apical Abscesses. Louis Henry Levy, M.D., Dental Cosmos, 64:1189, November, 1922

PRESERVATION of a tooth affected with apical abscess requires the most exacting care as to antisepsis and canal fillings, and even then failure is apt to result. Hoping that he might find a means of improving this method of treatment the author made a study of the effects of x-ray radiation used in conjunction with root canal sterilization and filling together with mouth prophylaxis. Results are more than gratifying. He reports: "After one treatment sinuses have cleared up, the discharge from the root canal diminished and in following treatments this has entirely disappeared. * * * The roentgenograms show that the abscessed cavity begins to become smaller with the second treatment. The number of treatments for closing up the cavity vary from two to five and are given a week apart. A complete closing up of the cavity depends upon not only the proliferation of new granulation tissue, but also on the absorption of the cavity contents." No claim is made that the rays are bactericidal, but the indirect effects are.

The technique used was as follows: Spark gap 7 inches, about 100 kilovolts (crest value measured by the sphere gap), 5 milliamperes; target skin distance, 10 inches; filter, 4 mm. Al. The time varied from two to two and one-half minutes for the sensitive skin to three minutes for the average skin. This was for the first treatment; subsequent treatments were somewhat shorter in duration. Three minutes was the longest time and one and three-fourths the shortest.

The Incidents of Thymic Enlargement Without Symptoms in Infants and Children. Roy M. Greenthal, M.D., Am. J. Dis. Child., 24: 443, November, 1922.

THYMIC enlargement was diagnosed in 90 cases or four and one-half per cent of 2,000 consecutive patients admitted to the hospital. Of these 90 cases 87 gave no symptoms and presented no history of thymic enlargement.

Diagnosis of thymic enlargement was confirmed by percussion signs, by roentgenography of the thorax, by the disappearance of the shadow after exposure to x-ray treatment and by necropsy. Enlargement of the thymus was noted in 25.6 per cent of all patients of whom a roentgenogram of the thorax was taken. The author found that cases with congenital defects and malformations seemed more apt to have thymic enlargement than did others.

He also found that in all cases where there were no symptoms of status thymico-lymphaticus, but with roentgenographic evidence to the contrary, that the roentgenographic findings were usually verified either by reduction of the tumor upon x-ray treatment or by necropsy later.

In a number of sudden deaths following operative procedure the author found a "thymolymphatic constitution," and while this may have been purely a coincidence, he advises pre-operative radiation of the thymus in all cases even where there is no suspicion of thymic enlargement.

The infant's reaction to illness may often be dependent upon the thymic condition. A number of cases of severe reaction to various illnesses in infants of a "thymic constitution" are cited and the author arrives at the conclusion that the mortality rate of infants and children, of operative cases, and of some illnesses, could be lowered by thymic treatment even when there are no signs of thymic hyperplasia.

A.M.P.

Roentgen Studies of the Thoraces of the Stillborn and Newborn. Wm. A. Evans, M.D., Am. J. Roentgenol., 9:613, October, 1922.

IN CASES of asphyxia of the newborn respiration may be entirely absent, although heart beat is present, or it may be impaired. To discover the basis of faulty respiration in these cases the author made an x-ray study of the chests of stillborn and of newborn infants.

One interesting fact is that several of the plates showed the tracheal shadow throughout, thus negativing "Mink's contention that the fetal air passages are collapsed and that the glottis and nostrils are closed."

Insufflation was tried in several cases of faulty respiration but the author decided that this method had no merit and had the disadvantage of widely distending the stomach and intestines.

A large thymus shadow was always present in a case of faulty respiration but the reverse condition was not found true.

Non-expansion of the lungs was noted in many cases and in all cases of unilateral non-expansion the lobe of the thymus on the affected side showed the greater enlargement.

Deformity of the cardiac outline was noted in several cases of faulty respiration but study of this condition is not yet sufficient to warrant the classification of such deformities although a disturbed circulation is thought to be a factor in the faulty respiraion.

Fundamental Principles of Radiation Therapy with Clinical Results Possible. A. F. Tyler, M.D., Nebraska M. J., 7:370, November, 1922.

THE fundamental physical and clinical problems of radiation therapy are touched upon and the relative value of surgery and radiation therapy is discussed. Radiation therapy is decidedly advocated in cases of cancer of the lip and in those of the cervix uteri. In his comparison of radium and x-ray as to their physical nature and the effects, the author emphasizes the necessity of using x-ray as well as radium in the treatment of pelvic cancer. Radium alone in such cases can not accomplish the end sought.

In discussing the clinical effects and results the author says: "Massive carcinoma of the pancreas, of the stomach, and of the pelvis are reduced within a few days time to a size which is not palpable. * * * I have repeatedly seen malignant masses the size of a cocoanut reduced one-fourth in size within twenty-four hours after the first treatment had been administered. Sarcomas respond with even greater rapidity than carcinomas." Eight case reports of diverse lesions are submitted.

Nausea is reduced to the minimum by the following method: The patient is hospitalized twenty-four hours before radiation treatament is begun and an alkaline cathartic is given. The patient is kept quietly in bed during this time, only a liquid diet is allowed, and thirty grains of sodium bicarbonate is given every three hours. Radiation treatment is stopped as soon as nausea manifests itself and is not resumed until the next day when as a rule the patient can stand a longer period of treatment. Action on the tumor is just

as effective as would be the administration of radium for a longer period, and the general condition of the patient is much better than it otherwise would be.

Intensive Deep Roentgen Irridation. J. Henry Schroeder, M.D., J.A.M.A., 79:1240, October 7, 1922.

"MY OBSERVATIONS are based upon a series of 100 intensive deep roentgen irradiation doses that I have applied since therapeutic apparatus for this purpose has become available in this country."

A voltage of 200,000 to 220,000, Coolidge deep therapy tube, copper filters from 0.5 to 1 mm., an area of 20 by 20 cm., and a distance of from 50 to 80 cm. were used. The Wintz erythema dose was used.

The author's summary is as follows: "(1) Large doses of intensive deep roentgen irradiation with ultrahard rays, with proper precautions have been administered to patients who were not cachetic. (2) The general systemic effect, is, under these conditions less distressing than formerly, after irradiation with the soft rays. (3) The immediate effect on the blood and blood-forming organs is marked, but restoration begins as a rule within a week after the irradiation in noncachetic cases. Hemorrhages from internal malignant growths ceased; this result alone is of immediate benefit to the patient. (4) The immediate effect of therapeutic doses on the deeper organs in irradiated areas is that of irritation, and probably corresponds to a surface erythema. Glandular tissues may be destroyed. (5) In noncachetic patients, a surface erythema from these ultrahard rays was safely produced when necessary. It must be attained whenever a malignant mass near the surface is to be treated through one area of entry. (6) The iontoquantimeter permits the administration of the desired and known depth dose, and is the basis of scientific deep roentgen therapy."

The Effect on the Metastatic Tumors of the Primary Tumor. W. Baensch, M.D., Fortschr. a.d. Geb. d. Roentgenstrahlen, 29:499, June, 1922.

SHMEIDEN found that receding changes following irradiation of the primary tumor were not confined to the primary growth but were noted in the metastatic nodules as well. To verify these observations the author made a special study of a number of cases in the Payr clinic.

He found that in hematogenous metastasis arising from a primary carcinoma of the rectum and found in the liver and spinal column that the metastatic lesions were not influenced by heavy successful irradiation of the primary tumor but on the contrary some of them showed increased growth and dissemination. He therefore concludes that a hematogenous metastatic tumor must be subjected to the same quantity of irradiation as is the primary tumor.

The author had three cases of carcinoma of the face with typical submaxillary metastasis, one carcinoma of the bladder with inguinal gland involvement, and two carcinomas of the breast with axillary involvement. In these cases the primary tumor was subjected to heavy irradiation while the metastatic nodules were well covered with lead. With the resolution of the primary tumors there were simultantous resolutions of the secondary metastatic lesions. The author's explanation of this is that in these tumors the lymphatic tissue was sufficiently powerful to destroy the weak carcinoma cells, providing the primary source of supply was cut off. A.M.P.

The Effect of the Size of Radium Applicators on Skin Diseases. Edith H. Quimby, M.A., *Radium Research Laboratory, Memorial Hospital, New York City.* Am. J. Roentgenol, 9:671, October, 1922.

THE author's summary is as follows: "(1) A method is outlined for determining the intensity of radiation from any applicator, in terms of the intensity from a point source of the same strength. (2) General curves are given for tubular, circular, square, and rectangular applicators, for filters of 0.0, 0.16, 0.50, 0.75 and 2.0 mm. of brass. (3) Several examples are worked out to illustrate the uses of these curves. (4) A table is calculated from the curves for obtaining the intensities of radiation from about 100 definite applicators, at several definite distances, in terms of the intensity from a point source of the same strength at a distance of one centimeter. (5) Doses in millicurie hours are given for applicators having filtration equivalent to 2 mm. of brass and 2.4 mm. of rubber. (6) Doses for different applicators, clinically determined at the Memorial Hospital, are shown to check the calculations and curves of this paper.

Protection to the Operator from Unnecessary Radium Radiation. Albert Soiland, M.D., Am. J.Roentgenol., 9:683, October, 1922.

TOO many workers are careless in their handling of radium element partially screened by metallic containers. Radium containers should be left "severely alone" except when handling them is absolutely necessary.

Protective measures must be painstakingly thorough if they are of any real value. A little carelessness may produce serious consequences. Adequate protection is possible and from now on workers themselves are to blame if untoward consequences result to themselves.

In the writer's laboratory body screens having a curved surface are used and long forceps are employed to handle the radium element whenever possible. Lead blocks are used which are perforated to hold the needles, only the eye being exposed. All accessories for handling the radium are prepared beforehand to lessen the time of contact. When adhesive which has been used in making the radium application is to be removed, simply dropping the mass into a cupful of benzine will facilitate removal of the adhesive and shorten the time of exposure.

Varicus protective devices are procurable from all dealers in x-ray apparatus and there is no longer any excuse for workers exposing themselves as once was necessary.

Where large quantities of radium are used daily there should be an alternation of workers from month to month, and a tabulated blood count of all workers should be kept.

Effects of the X-rays and Radium on the Blood and General Health of Radiologists. George E. Pfahler, M.D., Am. J. Roentgenol., 9:647, October, 1922.

DR PFAHLER cites the known cases of death from direct or indirect exposure of radiologists and their assistants to radium and x-rays. The investigations of workers both here and abroad are reviewed.

Dr. Pfahler concludes as follows: "(1) Undue exposure to the x-rays or radium is associated at times with a moderate leukoplakia, a relative lympho-cytosis, a relative polycythemia, and occasionally an eosinophilia. (2) A low blood-pressure, which does not seem to be associated with any other definite symptoms is quite common in radiological workers. (3) The asthenia, sometimes noted, can probably be accounted for by strenuous work, caused by the great interest and also by the desire to meet the heavy "overhead" charges which must be carried by the radiologist. These symptoms are also probably caused by close confinement, lack of fresh air, and lack of recreation. (4) The skin chánges found in the earlier workers are not increasing, and are being avoided entirely by the younger ones, because of increased knowledge and increased protection. (5) Complete protection can undoubtedly be obtained. It requires not

only the means, but continual caution on the part of the individual. (6) Increased protection is needed by those who are working with the gamma rays, or with the higher voltage x-rays. (7) A dental film carried in the pocket for two weeks will give a quick index of excessive exposure. If definitely fogged or blackened, protection should be increased. (8) Shortening the hours of work and increasing the amount of fresh air and recreation will probably remove symptoms, and prevent future trouble."

A Plea for Closer Relations Between Cardiologist and Roentgenologist. Pedro Ramos-Casellas, M.D., J.A.M.A., 79:1406, October 21, 1922.

DIAGNOSIS of cardiac lesions by means of the x-ray alone should not be attempted, but "few internists now call the cardiac examination complete until an accurate measurement of the heart's silhouette has been made."

The French school uses fluoroscopic methods alone. The American school uses the plate in addition to the fluoroscope.

The purpose of this article is to show "in a general way, how much information can be furnished to the cardiologist by careful tracings on a cardiagram." Roentgenologic findings must, however, be cautiously considered because of the variable factors involved.

Cancer from the Viewpoint of the Pathologist. H. H. Plowden, M.D., J. S. Carolina M. A., 18:301, October, 1922.

A CHARGE brought by the writer is that much of the physician's ignorance of the subject of cancer is due to the "chaotic condition of the literature upon the subject." There is need "for a book of ready reference, of convenient size, giving in succinct and available form a summary of knowledge concerning the subject, and the next rational procedure should be the undertaking of such a task by a man of the medical profession whose standing is secure, whose reputation is national and whose word is truth."

The original paper contains a brief discussion of the distinctions between benign and malignant tumors.

Delay in the Treatment of Cancer. Charles E. Farr, M.D., Am. J. Med. Sc., 164:742, November, 1922.

IT IS claimed by the author that poor medical advice all too frequently is responsible for deferred treatment of cancer cases. He maintains the correctness of this charge by relating an investigation instituted several years ago by the first surgical division of the New York Hospital and recently carried further.

At the time of the first investigation one of the leading medical journals of the country refused to publish the data then secured, saying that they cast a reflection upon the profession of medicine; however, another leading paper did publish them.

The author says in his present communication: "It must be remembered that the facts were obtained by many different men, working in ignorance of any desired goal, and that the tabulations and comparisons have been made by still other men, selected for their special knowledge and training, but not the responsible surgeons in charge. * * * Inaccuracies naturally will creep into such a compilation, but we trust and believe that we have approximated the truth. Our findings are that a delay of approximately one year occurs in the average case before adequate surgical care is sought. This means a delay after the development of symptoms or the appearance of a growth."

In summing up the investigations he says: "One hundred and fifty cases gave time lost after symptoms developed and before consulting a physician from no time to ten years. Average time twenty-four weeks."

Time from consulting a physician to time of entering a hospital was obtained in 141 cases. "It ranges from no time lost to nine years. With one exception all who waited over one year were cases in which the physician gave wrong advice. * * * Sixty-eight entered the hospital within one month from the time of consulting a physician. * * *

"Time from onset of symptoms to time of entering hospital in those cases in which it was not stated when the physician was consulted, 90 cases, excluding those given above."

He tabulates his data thus:

Physician's Advice:	Total	Right	Wrong
Number curable	43	32	11
Probably curable	24	13	11
Incurable	83	39	44
Operable	74	51	23
Inoperable	76	33	43

Salt Solution in Radiation Sickness. E. Schlagintweit *and* H. Sielman., Klin. Wchnschr., 43:2136, October 21, 1922.

THESE authors believe that radiation sickness results from a disturbance of the sodium chloride metabolism The salt concentration in the serum falls rapidly after radiation, remains on this level for a few hours and slowly returns to normal. Due to this change there occurs a change in the osmotic pressure bringing about the syndrome of radiation sickness. It is suggested that this condition be remedied by supplying the necessary quantity of salt.

The authors treat radiation sickness by injecting 300 to 1000 cc. of physiological salt solution per rectum, or 5 to 10 g. per os. or 1.0 g. in five per cent solution intravenously. It must be administered slowly.

This treatment always proved to be successful. About fifteen to twenty minutes after the injection, especially in the intravenous method, marked improvement was noted. Nausea and vomiting ceased and patients asked for food. There can have been no possibility of a psychic effect as the patients did not know the object of the injection.

The authors recommend this treatment most enthusiastically.

A.M.P.

Treatment After Irradiation with Roentgen Ray. Joseph K. Narat, M.D., J.A.M.A., 79:1681, November 11, 1922.

THE general and the local after treatment are both considered. The author's own summary is given as follows: "(1) A roentgen toxemia appears insidiously, but nevertheless may cause serious disturbances and even roentgen cachexia. To avoid it, the roentgen technique ought to be accommodated to the general condition of the patient. (2) A renal function test should be made before irradiation. (3) Plenty of water by mouth, protoclysis, hypodermoclysis, mild cathartics, diuretics and blood transfusion eventually, preceded by venesection, help to dilute and eliminate the toxic material. (4) Irritating drugs should not be applied to the skin for three weeks after irradiation."

Postmortem Radiography. James A. Honeij, M.D., Boston M. & S. J., 187:545, October 12, 1922.

POSTMORTEM radiography is urged as a routine procedure in all cases where the cause of death is questionable. "A large amount of labor would be saved, a record of pronounced value obtained, and corroborative evidence had which the coroner could use with effect in presenting evidence in court in medico-legal cases. * * * Here is a field, apart from its more practical aspects, for research that has not been touched and which, to my mind, may give results which cannot as yet be overestimated."

Dangers and Limitations of X-rays and Surgery. C. F. Hegner, M.D., Colorado Med., 19:206, October, 1922.

THE roentgenologist must be an expert technician, physiologist, excellent anatomist, and a thoroughly qualified pathologist, and he must be of such a temperament that he will cooperate wholeheartedly with internist and surgeon. His value as a consultant depends upon the degree of his possession of these qualities.

Use of the x-ray is absolutely requisite in all cases of fracture. The misinterpretation of shadows may sometimes result in a diagnosis of a non-existent fracture, and displacement of fragments may be so distorted on the plate, especially with careless or improper technique that pernicious surgical activity is thereby instigated.

Clinical symptoms are too often disregarded by the roentgenologist. "Cock-sureness" on the roentgenologist's part leads to disparagement of his specialty. "X-ray should always be used whenever and wherever possible, not as a crutch for a weak clinician to lean upon, nor as a makeshift for the carless, but as a corroborative aid and check on other diagnostic data."

In malignancy the writer believes that operation should be the first procedure in all operable cases and that it should be followed by prompt radiation.

The Roentgenologis and the Urologist in the Diagnosis of Renal Disease. F. Granville Crabtree, M.D., *and* William M. Shedden, M.D., Am. J. Roentgenol., 9:362, October, 1922.

TWO purposes must be kept in mind in routine examination of the kidney and ureters, namely, to show suspicious densities and to estimate the normality or the abnormality of the size and position of the kidneys.

Any x-ray examination which does not show definite outlines of the kidney shadow is unsatisfactory.

Tumors, stones, infections, stasis or any combination of these comprises, briefly, the clinical pathology of the kidney.

Tumors may be shown by enlargement of the kidney shadow or by its deformity from pressure. Tumors of the kidney may arise in either the upper or the lower pole and they may become very large without producing further deformity than in the upper or the lower calices. Papillomatous growths are difficult to diagnose. All the other forms of kidney tumor, and retroperitoneal growths in particular, are apt to carry the kidney and ureter out of position. Polycystic kidney is usually indicated by elongation of the pelvis and calices. Enlargement of Riedel's lobe of the liver may deform the kidney by compression and so be mistaken for kidney tumor.

In cases of stone attention should be centered upon the kidney rather than the stone. The thing of first importance is to ascertain whether the kidney itself is worth an attempt at preservation and whether its mate can "carry on" alone. The guide here is the nature and extent of the dilatation. Without these data no operation should be performed, nor should the stone be removed and an embarrassed kidney be left to function as best it may when proper treatment and care could relieve it of unnecessary work.

Infections are of either the pyelitis type (colon bacillus), staphylococcus type or tuberculous type. Stricture, aberrant vessels, congenital malformation or a sagging kidney may be a factor in kidney infections.

Abscess in the cortex or the pyramid is not always recognizable by means of x-ray. However, an abscess cavity which can be filled with injected material or a swollen papilla encroaching upon and flattening the neighboring calyx can be demonstrated on the plate.

Irregular glandular calci of the kidney leads to a suspicion of tuberculosis but most tuberculous kidneys do not show calcification but irregular extensions of the injected material, outside the line of calices, may sometimes be demonstrated.

Stasis is classified as acute, subacute, intermittent and relative. The first type may arise from swelling due to acute disease, from a stone passing down the ureter or from a blood clot. The commonest form of the second type arises during pregnancy. The third type is perhaps of commonest occurrence and is usually accompanied by a sagging kidney but a low kidney and crooked ureter should not be taken as the cause of the stasis unless confirmed by the cytoscope. The fourth type is found in those kidneys which show little effects of back pressure through flattening of the pyramids, yet the pelvis and the whole of the ureter and its orifice are dilated, which condition is so far inexplicable.

In making an x-ray of the ureter the patient will be much more comfortable if the pelvis is completely emptied of fluid before the catheter is introduced. It should not be expected that kinking of the ureter can be demonstrated by x-ray if a stiff catheter is passed into the pelvis of the ureter, it must first "be pulled down to the brim of the bony pelvis" when the ureter can be injected and the kinks then can be demonstrated, if they exist.

If kidney shadow is persistently absent then one must suspect a nephrectomy, a congenitally small kidney or else a congenitally malposed one; or hydronephrosis may account for the absence of shadow. In the last case the cortical substance is so extremely thin that the shadow may not show. If in a gastro-intestinal examination no definite kidney shadow is seen but the bismuth filled intestines seem to be pushed away from the kidney region then hydronephrosis should be suspected.

The writer especially emphasizes the fact that a bilateral pyelography is necessary and that cystoscopic estimation of the capacity of the pelvis should also be made.

Radium Versus Surgical Removal of Carcinoma of the Bladder. B. S. Barringer, M.D., J.A.M.A., 79: 1504, October 28, 1922.

THE work upon which this report is based covers the period from December, 1915, to January, 1922.

Both operable and inoperable cases have been treated, some by radium alone and some by operation followed by radium.

A number of the patients in each of these groups have remained free from recurrences for varying periods and the results from radium treatment are considered favorable enough to continue this method. More accurate dosage and application has been developed as a result of experience along this line and better results are hoped for in the future.

For the past three years the author has applied radium to the base of the tumor through a suprapubic opening of the bladder in cases where the growth was too large to be treated intravesically.

Radium Therapy with Special Reference to Diseases of the Female Pelvis—A Rejoinder. Howard A. Kelly, M.D., Therap. Gaz. 46: 761, November, 1922.

THIS is a very lively, if belated, rejoinder to one for whom the author professes his personal attachment and esteem.

Among the lesions benefited, if not cured, by radium, Dr. Kelly enumerates lymphosarcoma and angiosarcoma of the nasopharynx and of the whole body, Hodgkin's disease, leukemia, mediastinal tumors, brain tumors, primary testicular carcinomas, sarcomas of the ovary in children, and many other ailments.

Most of the article is occupied with a discussion of the results obtained by radium in cases of fibroid of the uterus, hemorrhagic uterus, cancer of the body of the uterus, and cancer of the cervix.

The writer modestly claims his own laurels as a surgeon, and pays high tribute to his specialty in general, but

he speaks in no uncertain terms his opinion of those surgeons who will not open their eyes to see what the new light of radiotherapy would reveal to them.

Of fibroid tumors he says: "He who would give his patient the same consideration he would give his wife or his sister, must put radium first in the treatment of fibroid tumors." Not all fibroids need treatment, in some operation is still the method of choice, but in some radium is just as surely preferable. The details are discussed in the original communication.

Of cases of hemorrhagic uterus he says: "At last in this emergency of the hemorrhagic uteri, when we were doing such a tremendous operation merely to check hemorrhage, radium came to our aid, and * * * presto! the hemorrhages disappeared and the patient was cured." In answer to Deaver's charge of inducing thereby an artificial menopause Kelly replies that "this condition is rarely found in young women, nor is radium used in young women until every other means has been exhausted, and when as a last resort the mutilation of hysterectomy looms up as necessary to save life, or to forefend permanent invalidism." Also he asks what is done to the function in question when the uterus is extirpated for hemorrhage.

Of cancer of the body of the uterus he says: "I have seen many women with cancer of the body upon whom it was impossible to operate and where radium was the only hope; practically every one has been benefited and here and there one is apparently cured. I still believe that surgery is the method of choice, but I am thankful where surgery is excluded to be able to use radium with so much success and the hope of a prolonged and remarkable improvement."

Respecting treatment of cancer of the cervix uteri Kelly asserts that Deaver has arrived at false conclusions by comparing data from utterly different groups of cases. Respecting Clark's data cited by Deaver the writer says: "I wrote at once to John G. Clark and asked him whether or not in his citation he had included all cancer cases in his list of radium cures, or merely those which were also favorable from an operative standpoint. He replied that the two groups were utterly diverse and not to be compared at all, that his radium cures included all cases indiscriminately. I quote from his letter of July 18th: 'You are quite right in your interpretation of my viewpoint. Of the large number of cases which we have treated for the last year or two practically none were operable, and because of the astounding good results in some of the apparently hopeless instances, we have very materially decreased the number of our operations in cancer of the cervix. Indeed we scarcely operate any more in the latter cases.' "

The three groups of cases of cancer of the cervix considered from the standpoint of the radiologist are: (1) Those "with extensive lateral involvement and fixation. (2) Where the lateral infiltration is moderate and where neither side is fixed. (3) Where the disease appears limited to the cervix and mobility is not interfered with." In the first group "operation is worse than futile," radium palliates and occasionally cures; in the second group surgery should not be used for it practically never cures, radium often brings about a cure; in the third group a combination of surgery, if possible, and radium is the method of choice. Radium alone cures these cases in the last group more often than does surgery alone but neither one alone is advised if the combination is possible.

In conclusion he says: "It would take a large volume to record all the triumphs of radium. It has come to us as one of the most valuable adjuvants our therapeutic armamentarium has ever welcomed. So far as I know, no one has ever professed that it was a panacea. Exaggerations have been limited for the most part to the public press."

Tumors of the Breast. Joseph C. Bloodgood, M.D., Northwest Med., 21:338, September, 1922.

ONLY about fifty per cent of the breast cases in the author's present practice require operation, whereas in his early practice it was the rare exception to have a patient report a breast lesion before it was far advanced.

Halsted, Fenger, Senn, Warren and others of the old school had developed the sense of palpation to a high degree, unsurpassed by very few even today. This method of differentiation should be more cultivated than it is at the present time; the mere fact of lumpiness should not be taken as evidence of tumor, for there are many lumpy breasts, in fact, the average breast is lumpy without any pathology being present. Bloody discharge from the nipple should not be taken by itself as an indication of malignancy and the same is true of pain.

If inspection and palpation leave one in doubt then the exploratory operation is necessary. Every surgeon should be thoroughly familiar with the blue dome cyst and the encapsulated adenoma. If he has an absolute and certain knowledge of these two lesions then he will be safe in treating all others as cancerous.

Of x-ray and radium for breast cases the author says: "The only new problem * * * is whether you should give x-ray or radium before the operation. That problem is yet in its experimental stage." He does not say anything regarding postoperative radiotherapy other than what may be inferred from the statement just quoted.

Treatment of Recurrent Inoperable Carcinoma of the Breast by Radium and Roentgen Ray. Burton J. Lee, M.D., J.A.M.A., 79:1574, November 4, 1922.

CASES treated in the breast clinic of the Memorial Hospital during 1918, 1919 and 1920, 218 patients in all, furnished the data from which the author has drawn these conclusions: "(1) As a prophylaxis against the recurrence of breast carcinoma, a careful selection of patients for operation must be made. (2) Pre-operative and postoperative cycles of roentgen ray are important prophylactic measures against recurrence. (3) A follow-up in every patient with carcinoma of the breast operated on should be adopted as a routine. * * * (4) Properly applied irradiation to recurrent breast carcinoma definitely prolongs the life of the patient. (5) I believe that ultimately, with more complete knowledge and better technique, a still further control of the recurrent phase of this disease may be expected.

In the original paper the prevention of recurrence, results of treatment, and types of lesions for which radium is best suited, and for which roentgen rays are best suited is discussed.

The Treatment of Benign Conditions of the Pelvis with Radium. Leda J. Stacy, M.D., Am. J. Roentgenol., 9:658, October, 1922.

DR. STACY of the Mayo Clinic believes that radium "is the treatment of choice in cases of menorrhagia of menopause associated with fibromyomas not exceeding in size a four months' pregnancy, or of a fibrous uterus, in which the possibility of malignancy is eliminated by the history or by a curettement. Small doses of radium are indicated in a few carefully selected cases of menorrhagia in young women of the child-bearing age. A history or evidence of pelvic infection is a contraindication to the use of radium. In adenomyomas which are adherent and difficult to remove, the use of radium is preferable to surgery. Treatment with radium relieves the symptoms in certain cases of pruritus vulvae and in kraurosis associated with pruritus. Endocervicitis continuing after an abdominal hysterectomy responds satis-

factoriy to one or two treatments with radium."

The Treatment of Carcinoma of the Uterine Cervix. Stanley A. Clark, M.D., J. Indiana M. A., 15:339, October, 1922.

IN HIS treatment of this subject the author mentions the discouraging number of cures resulting from operative procedure and he says that from personal observation and experience he has come to the conclusion that the combined use of radium and x-ray is the treatment of choice. A brief review of the literature of the past year confirms him in his belief.

Results of Radium Therapy in Climacteric Hemorrhage. James Heyman, M.D., *Institute of Radium. Stockholm,* Acta Radiologica, 1:470, August, 1922.

THE following is a translation of the author's own summary of this article:

From 1916 to 1921 there has been treated at the Institute of Radium at Stockholm 49 cases of uncomplicated climacteric hemorrhage. All were treated by radium. Only one treatment was given in 41 of these cases, 30 were intrauterine and 11 were vaginal applications. In seven cases two treatments were given and in one case three were given.

Results: Amenorrhea was produced in 32 cases and oligomenorrhea in 16 cases. One case was unsuccessful.

The Simultaneous Occurrence of Tumors in the Thyroid, Uterus and Breast. Max Ballin, M.D., *and* R. C. Moehlig, M.D., J.A.M.A., 79:1243, October 7, 1922.

THE author's summary is as follows: "In a series of 200 cases (100 fibroids and 100 goiters) 53 patients or 26.5 per cent had both goiter and fibroid Five per cent had breast tumors. (2) The age of incidence of these combinations was greatest after 35. (3) Since these three organs are not related anatomically or embryologically, the simultaneous occurrence of tumors in the thyroid, uterus and breast may be explained by their physiologic interrelationship. (4) The prophylactic treatment now advocated, of giving iodids for goiter, may likewise prove beneficial in the prevention of fibroid. (5) Perhaps certain goiters can be reduced in size or even cured by the removal of a fibroid (as suggested by Ullman)."

Th Desperate Risk Goiter. Martin B. Tinker, M.D., J.A.M.A., 79:1291 October 14, 1922.

DESPERATE risk cases are those hyperthyroid cases which have obstinate gastro-intestinal symptoms, very high blood pressure and myocardial insufficiency.

"Some will ask why we do not use the roentgen ray or radium. In the first place, we surgeons not only see the failures from these and other measures of treatment, but we see patients that are actually worse or badly burned, although treated by supposedly experienced operators. In the second place I do not believe dosage can be accurately enough controlled to avert myxedema. In the third place, having lived long enough to see the passing of various serums, injections and other cures in the hands of good men, I am willing to await permanent results. Thus far since Kocher's series of the early nineties, no method but surgery has stood the test of time."

A Simplified Pneumoperitoneum Technique. L. R. Sante, M.D., Am. J. Roentgenol., 9:618, October, 1922.

STEWART and Stein advocated simplicity of apparatus and procedure in pneumoperitoneum, but their advice has been lost sight of by many of their followers, and consequences are not always all that either the operator or patient might wish.

Pneumoperitoneum to be successful must be capable of production with simple apparatus easily procurable and must be so simple that any medical man can perform it. Also it must be convenient and not require a long time for its performance, it must be safe for the patient and of the least possible discomfort to him.

The author believes that he has hit upon an apparatus and method which more nearly fulfills these conditions than any others now in use. Full description and illustration of the apparatus and technique for its operation are given in the original paper. No special apparatus is necessary and no gas tank is required. The author does not assert that his method is positively safe as regards the life and condition of the patient, but does assert that it is safer than "some other diagnostic methods employed daily by internists and surgeons."

A Clinical and Roentgenographic Study of Gastroptosis. Seale Harris, M.D., *and* J. P. Chapman. M.D., J.A.M.A., November 25, 1922.

GASTROPTOSIS should be termed a physical characteristic and should not be considered as an anomaly or a disease.

The x-ray has dissipated the dictum that a normal stomach must, in every individual, occupy a certain circumscribed and definite location. The error of the older anatomists lay in the assumption that the stomach must always be found in the same position it is found in the supine body, that is, usually in the upper left quadrant of the abdomen, with the dome lying in the vault of the diaphragm and the lower border about two inches above the umbilicus.

Over one thousand gastro-intestinal patients were examined by this author. X-ray study has shown that there is a marked mobility of the stomach which is affected by the position and type of the individual, by the weight of the stomach, and by the tension and relaxation of the abdominal muscles.

In the slender flat-chested person, having a slender abdomen, the stomach will most often be found in the lower left quadrant of the abdomen, when the patient is in the standing position, and this location is normal for this type. Differences in the size and shape of the chest will result in all sorts of locations between this last described position and the one formerly thought to be the normal one.

A Review of 3,500 Roentgen Examinations of the Alimentary Tract. Richard A. Rendich. M.D., Long Island M. J., 16:456, November, 1922.

THE larger number of these examinations were made at Bellevue Hospital. The "tabulations are made only according to radiographic findings of this tract * * * cases presenting multiple lesions are classified under that which was considered most important from a symptomatic viewpoint. Pathological processes of the respiratory, cardiovascular and other systems discovered during routine gastro-intestinal study are not included, as separate reports describing such lesions in detail were made after the necessary examination."

Haudek's double meal m.thod was employed, a motility meal was given six hours previous to the first examination and a second observation was made twenty-four hours later and each day thereafter until the mixture had been completely evacuated.

The fluoroscope was depended upon for most of the information but plates were made for a record and for detail study whenever this procedure seemed indicated. In many cases where manipulation was necessary to demonstrate the deformity the plates were made during fluoroscopy. Repeated examinations were made in all doubtful or difficult cases.

Negative reports were given in 2,152 cases; the different lesions found and

the number of cases of these are shown in the following tabulation:

Esophagus	81
Organic Disease of Stomach	101
Asso. Gastric and Duod. Ulcers	4
Gastritis	8
Carcinoma	174
Pyloric Obstruction	10
Postop. Conditions of Stomach	79
Postop. Conditions of Colon	12
Organic Disease of the Duod.	183
Disease of the Appendix	174
Adhesions	89
Organic Disease of Colon	105
Functional Disturbances	100
Congenital Anomalies	16
Disease of Liver	28
Disease of Gall-Bladder	109
Extra-Gastric Conditions	71
Miscellaneous	24

Ascarides in the Gastro-Intestinal Tract as They Appear in the Roentgenogram. Otto Fritz, M. D., Fortschr. a.d. Geb. d. Roentgenstrahlen. 29:591, July, 1922.

ASCARIDES in the gastro-intestinal tract often cause no essential local disturbances, but produce general symptoms such as enteritis, colics, nausea, anemia, itching, etc., which are caused by poisonous metabolic products of the ascarides.

Due to their tendency to crowd into narrow canals and ducts, they not infrequently cause severe lesions such as liver congestions, abscesses, or obstructions. If as sometimes happens, they pass through the duodenum into the stomach, they may be observed in the vomitus or may be aspirated into the lung passages. It is therefore quite necessary after the laboratory examination has revealed the ova in the feces, to determine in which part of the alimentary tract they are found.

In two cases the author found a spiral shaped object about the length and thickness of a goose quill, once it was observed in the stomach and at another time it was observed in one of the coils of the jejunum, both times it showed up distinctly in the surrounding substance of the opaque medium.

A.M.P.

The Mechanism of the Gastric Movements in Man as Observed by Roentgen Methods. E. Egan, M.D., Fortschr. a. d. Geb. d. Roentgenstrahlen, 29:597, July, 1922.

CONTRARY to the usual teachings, the author found from fluoroscopic observations, that the emptying of the stomach contents is not the result of reflexes emanating from the duodenum. The opening and closing of the pylorus does not result from chemical or mechanical stimulation to the sphincter. Hyperacidity appears to act very much in the same way, as far as opening and closing of the pylorus is concerned, as does an anacidity.

Quoting the conclusions of McClure and Reynolds that the degree of acidity has no bearing on the opening and closing of the pylorus, and the conclusions of Wheelon and Thomas that the motility of the antrum determines the motility of the sphincter, the author is in agreement with Schlesinger that the opening and closing of the pyloric ring is produced in a purely mechanical manner. Fluroscopic observations show that in stomachs of normal tonus the pyloric sphincter is partially open even when the stomach is empty, as evidenced from the fact that the first portion of the opaque suspension nearly always passes out through the pylorus, immediately, without any hindrance. The further portions pass out whenever there is considerable contraction of the antrum. The explanation offered is that the longitudinal muscle fibers of the stomach which end in the pylorus when undergoing contraction pull the opening apart, thus allowing the ingesta to be pushed through. At the resting phase of the fibers the pull is released and the sphincter contracts again.

—A.M.P.

Gall-Bladder Disease. A. Johnson Buist, M.D., J. S. Carolina M. A., 18:281, October, 1922.

THE function of the x-ray in the diagnosis of gall-bladder disease is in the elimination of the stomach and duodenum as the source of symptoms. The writer claims that in only a few cases do the rays reveal gall-stones, even when these are present.

Inflation of the Colon for X-ray Examination of the Intra-abdominal Organs. A. Henszelmann, M. D., Fortschr. a. d. Geb. d. Roentgenstrahlen, 29:465, June, 1922.

AFTER remarking that inflation of the colon has long been used for percussion purposes, that there is no danger or discomfort to the patient from its use, and that in most cases it can replace the Rautenberg method (pneuoperitoneum), the author states he has found his method highly useful in a large number of cases. Examining the patient with the insufflated colon in various positions, and regulating the inflation according to the particular needs, many data can be obtained regarding the spleen, liver, and gall-bladder. It is especially useful in the obese, in presence of ascites, defensio-musculorum, abdominal tumors, etc., where percussion and palpation yield no results.

A previous emptying of the colon is desirable but not absolutely necessary, except where the examination is made for the determination of the presence of stones in the gall-bladder.

The spleen can always be rendered visible by this method. If not in the anteroposterior view, it will certainly appear in the diagonal view, as it is often pressed toward the wall by the inflated colon. Slight enlargements of the spleen are easily appreciable. Cases of malarial enlargements have been diagnosed by the author after roentgenoscopic examination had shown the lungs perfectly clear.

In the examination of the right flexure the direction of the rays is of supreme importance. They should come obliquely from above downward, dorsoventrally. By this arrangement the lower edge of the liver is thrown downward along with the gall-bladder and both the upper and the lower edge of the liver will be visible. It will then be easy to differentiate between conditions of the liver and those of the pleura, lungs and diaphragm. The mobility of the liver can be determined and growths and scirrhotic conditions can easily be diagnosed from the appearance of the lower edge of the liver.

In examining the gall-bladder the fundus of the bladder can always be thrown into the air outline by directing the rays as described above and by turning the patient. Since in the reclining position the bladder is not extended and often projects backward the author makes this examination with the patient in the standing position. A slight overdistention of the colon may be found necessary, and it is usually harmless.

The enlarged gall-bladder appears in the mammillary line as a rounded projection of the lower edge of the liver. In cases of gall-stone with a history of previous attacks inflation of the colon may occasionally bring on an attack of considerable severity and care should be taken to avoid overdistention. The visualized gall-bladder can be palpated and tenderness elicited. But when the gastro-hepatic duodenal ligament seems shortened, with the pylorus, antrum and duodenum drawn forward to the right side the diagnosis of pericholecystitis can be made.

Care must be taken not to misinterpret haustral impressions for gall-bladder. Scybala must be carefully recognized and when necessary avoided by previous emptying of the colon. The kidney pole presents a different problem. The gall-bladder is directed more outwardly, both the lateral and medial contours are definite, while that of the kidney pole is deeper, lower, larger, and has a recognizable external edge with no internal edge. In comparison with the gall-bladder it moves but slightly with respiration. A.M.P.

Does Cancer Arise in Chronic Gastric Ulcer. W. C. MacCarty, M.D., J.A.M.A., 79:1928, December 2, 1922.

FROM the author's experience with 1,400 gastric specimens he has come to the conclusion that the possibility of cancer is always present in cases of gastric ulcer, and that there are no clinical nor laboratory methods by which the differential diagnosis can be made. Most chronic gastric ulcerations with a diameter greater than 2.5 cm. are cancerous, and when the roentgenologist discovers such a finding he is practically safe in making the diagnosis of cancer. The author would not temporize in a case of chronic gastric ulcer. He divides ulcers of the stomach into five groups, namely, simple, acute, peptic ulcer; tuberculous or syphilitic chronic ulcers, the chronic ulcer whose etiologic factors are unknown, the chronic ulcer having a neoplastic process in the borders of the mucosa, and the gastric ulcer which shows carcinoma not only in the borders, but also in the base.

Roentgenological Examinations of the Motility of the Stomach in Healthy Individuals During Rest and Motion. Aage Als Nielsen, M.D., *Municipal Hospital, Copenhagen*, Acta Radiologica, 1:379, August, 1922.

TWENTY stomachs of healthy individuals were examined, 10 men, 10 women, following the intake of a meal consisting of 300 grams of rice flour gruel and 100 grams of barium sulphate. Some of the individuals examined were at rest and some in motion.

The findings were as follows: The stomach empties more quickly during motion than during rest, and under each of these conditions the women's stomachs emptied more slowly than did those of the men. Normally, with the patient at rest, the stomach emptied within five hours intake of the meal.

Carcinoma of the Stomach. Byron B. Davis, M.D., Nebraska M. J., 7:365, November, 1922.

THERE are two main groups in the author's classification of this lesion. One group is composed of cases who have had a history of "dyspepsia" for a number of years before the trouble assumed a more serious aspect in their eyes. The second group is composed of those patients, generally past 40 years of age, who have had no trouble whatever in their earlier years.

The author discusses the symptoms of the disease and the value of different forms of examination with respect to diagnosis of the lesion.

A plea is made for constant propaganda regarding the cancer evil and medical men are urged to be more thorough in their examinations and more constant in their study of improved technique and methods of examination. Increased knowledge of cancer on the part of the public is already bringing increased responsibility to the physician and the conscientious man will prepare himself to meet this responsibility.

Of the x-ray the author says: "The x-ray intelligently used and skillfully interpreted is of much value, but even this aid, if unsupported by clinical evidence, may frequently lead one far astray. * * * In every case of gastric malfunction, whether it points toward cancer or not, I believe the x-ray should be made use of, but I strongly protest against drawing definite conclusions from the x-ray alone."

Reports of the First Bilingual Congress of Radiology and Physiotherapy—(Continued; Six Abstracts). Discussion on Deep Therapy, Concluded. Arch. Radiol. & Electroth., 27:98, September, 1922.

DR. VILVANDRE in his discussion advocated pathological as well as clinical diagnosis in connection with x-ray examinations and also advocated surgery whenever possible. He complimented the French upon their excellent work along the line of biological research as it applies to radiotherapy.

Dr. J. Owen Harvey emphasized the need of better technique in the use of homogeneous radiations of short wave length and the need of research along this line.

Dr. Martin Berry declared himself a disciple of Dessauer's system of measurement of dosage.

Professor Sidney Russ discussed the three variables present in the problem of radiotherapy. These are: (1) radiation, (2) tumor sensibility, (3) body resistance. He said that as a physicist he considered the present achievements in radiotherapy quite wonderful in face of the intricacy and mystery of its laws.

Of tumor sensibility he said the following: "Now, how great is the range of tumor sensibility? Is one tumor three, four or five times as sensitive to the measured dose of radiation as another, or has it a smaller factor? By this method, simple, of course, as a side issue, but nevertheless rather an illuminating one, we have so far carried out investigations on between 50 and 60 cases of malignant disease * * * cases of very considerable variety, sarcomas and carcinomas. * * * This tumor material, of varied histological type has all been given exactly the same dose of radiation * * * a quantity we call twice the lethal dose. You will quite understand that there was a difficulty about doing this in the human subject. It was decided to employ a factor of safety or two. All of these different types of tumors have had a dose of radiation corresponding to twice the lethal dose of the normal tumor, and of these 55 cases to date not a single case has grown. In this way the experiments might prove a useful contribution to setting the limits of x-ray action."

Dr. N. S. Finzi said that the Dessauer tables, while accurate for water, are not accurate for the human body, that the Dessauer method had the further disadvantage of exposing a very large total area of tissue to maximum radiations, and that even though a large area of skin is exposed in using this method there is, nevertheless, danger to the skin.

Sir Archibald Reid protested strongly against preoperative raying, as he believes the delay so caused is dangerous and the value of the procedure questionable.

Dr. F. Hernaman Johnson said that the reaction of surrounding tissue and of the body as a whole was to his mind a matter of great importance. Some way of raising the general resistance of the body before giving massive dosage is one of the great needs of radiotherapy.

On Penetrating Radiotherapy by X-rays and Radium. Robert Proust, M.D., Paris, Arch. Radiol. & Electroth., 27:121, September, 1922.

DR. PROUST limits his discussion to his own personal experiences of Curietherapy and radiotherapy at the Hospital Tenon and to the deductions arrived at through these experiences.

He believes that the biological effect of radiations is more dependent on their quality than on the dose absorbed, and he believes that the future of radiotherapy is bound up with the possibility of obtaining x-rays of shorter and shorter wave length.

Editorial Comment Upon Congress of Radiology and Physiotherapy, Section of Electrology. Arch. Radiol. & Electroth., 27:129, October, 1922.

DR. W. J. TURRELL and MM. Challiol, Laquerrere and Bourguignon voiced the opinion that all the physiological and therapeutic effects of direct current are due to ionic movements. Reasons were given "for believing in the occurrence of chemical rearrangements at the sites of virtual poles in the tissues in the path of the current between the skin electrodes."

Dr. Bourguignon described his "method of muscle and nerve testing by

condenser discharges and the determination of the chronaxie by this method." Editorial mention is made of Dr. Bourguignon's great labors in research along this line, from which far reaching results may come.

"The success of this section of the Congress justifies the hope that this is the first of a long series of such meetings, as they enable us to discuss our subject with friends and colleagues whose geographical separation from us causes the paths along which our work progresses to diverge from theirs at many points."

The entire October issue of the *Archives* is taken up with the papers read at the Section of Electrology. In addition to papers by those mentioned above there is one by MM. Menard and Foubert, which advocates abdomino-thyroid galvanization as the best method of treatment of symptoms of Basedow's disease. Another paper by MM. Ronneaux and Laquerriere is entitled "The Physiological and Therapeutic Action of High Frequency Currents" and takes up the general applications of medium tension, diseases of the circulatory apparatus, general applications of low tension and great quantity, applications of high tension, and physiological action, and the therapeutic applications of currents of resonance or of high tension. The last paper of the series is by M. S. Nemours-Auguste and is entitled "Pyloric Spasm and Painful Abdominal Cases Treated by High-requency Thermo-Penetration." Four case reports by M. Bonnefoy are appended to this paper. Two of these were cases of tubercular ulceration cured by applications of the high frequency current, one other was a case of fistula following appendectomy, and the fourth was a case of swollen and painful breast, diagnosed adenoma. The fistula is reported completely cured and the breast swelling was reduced and the pain relieved.

Considerations of Curietherapy of Cancer. Simone Laborde, *Chief of the Radiological Laboratory of Cancer Therapy in the Hospice Paul Brousse, Villejuif*, Arch. Radiol. & Electroth., 27:114, September, 1922.

A REVIEW of the well known biological technical, and clinical facts of radiotherapy is first given. This is followed by a discussion of biological, technical and clinical points which are as yet either obscure or disputed. The discussion covers the quality of rays in relation to their therapeutic effect, the distribution of rays, radiotoxemia, indications and contra-indications for treatment of various lesions, preoperative and postoperative treatment, and combined radium and roentgen treatment.

The views of leading authorities in the radiological world are constantly given place throughout this last discussion.

The author concludes by saying that the combined method of deep therapy (radium and x-rays) is of too recent date in France to form any conclusions upon the results as yet.

Cascade-Stomach. J. H. Douglas Webster, M.D., Arch. Radiol. & Electroth., 27:110, September, 1922.

CASCADE-stomach, an atypical form of hour-glass stomach, was first differentiated by Rieder. Barclay has recognized it, calling it 'cup-and-spill' stomach. Carman's view is that it is 'simply an hour-glass in which one portion of the stomach is not directly above the other, but they are shifted laterally.' But Schuetze points out that it is not an hour-glass in the usual sense (a B or X-shaped incisura or constriction), but more a drawing up of the posterior wall to such a degree, that on taking the opaque meal only the upper sac at first is visible, filling to a considerable extent before overflowing in an anterior or medial cascade to the lower sac, this method of filling being very different to the usual hour-glass; as a rule only very narrow organic hour-glass stomachs show considerable delay in the upper sac. Schuetze says a third sac has been seen, what he calls a 'cascade-waterfall,' related possibly to the very rare gastric diverticula described by Schlesinger (in a duodenal ulcer case) and others, Akerland having had a case with multiple diverticula (four or five) which I saw last year in his clinic.

"From a conversation with Barclay some time ago, I believe he regards the mechanism of cascade-stomach as a drawing up of the greater curvature by the oblique fibers to such a degree as to cause the deformity, and I believe he regards the condition as entirely spasmodic, as he has seen it present at one examination and absent at a later view of the same case."

A brief review of the literature is then given followed by two case reports and the author concludes that the whole subject requires further study before organic or spasmodic types can be clearly differentiated. It has been seen with "local lesser curvature ulcers, or adhesions; (2) pyloric and duodenal ulcers; (3) normal stomachs; (4) with extreme meteorism, especially with splenic colon gas distention; and (5) with extra-ventricular tumors."

The Normal Stomach. A. E. Barclay, M.D., Arch Radiol. & Electroth., 27:103, September, 1922.

DR. BARCLAY'S summary is as follows: "The normal stomach has no definite form. Its shape is subject to wide alterations within the bounds of normality. These alterations are chiefly due to changes in the tonus of the muscle. Tone is a 'posture' of muscle which is capable of maintaining a given form in spite of the action of gravity and other forces. Gastric atony (or rather impaired tone) differs from pure gastroptosis in the fact that the lesser curvature is not increased in length as compared with the normal—the converse holds good in gastroptosis.

"Peristalsis and tonic action are independent of each other, although apparently functions of the same muscle fibers. The oblique band of muscle fiber is probably responsible for taking the weight of the stomach and its contents. Experiments go to show that this band can, and probably does, act independently of the other muscular coats of the stomach."

The Roentgenogram of Acute and Chronic Bronchitis. M. F. Von Falkenhausen, M.D., Fortschr. a. d. Geb. d Roentgenstrahlen, 29:586, July, 1922.

TWO theories have prevailed regarding the normal lung markings. The one claims that these markings represent the bronchial walls, while the other attributes them to the blood vessels. The author made a large number of roentgenograms of cases of well developed bronchitis where all possibilities of the presence of tuberculosis had been eliminated.

The hilum shadow was not enlarged, but the markings of the trunks were especially intensified, broadened, and enlarged. The branchings were also more prominent, but there was no enlargement of the twigs near the periphery. Mostly they reached out to the periphery. The trunks of the lower division of the bronchial tree had undergone most changes, and in some places adhesions to the diaphragmatic pleura were recognized, the diaphragm shadow showed angulation on inspiration. The middle and upper trunks showed less changes. In very acute conditions there can be found in the course of the subdividing trunks small dense bean-sized spots which represent small circumscribed bronchopneumonic lesions (Cases of bronchitis with rise in temperature are usually of this type—A.M.P.). Generally the changes are less noted in the acute cases than in the chronic.

Based upon these findings the author comes to the conclusion that the normal lung markings represent the bronchial walls, as the blood vessels of the

smaller circulation would not undergo such enlargement.

The author calls attention to the fact that peribronchial thickening has been described as a tuberculous lesion, and says that the picture is often found in purely bronchial conditions.

A.M.P.

The X-ray in the Diagnosis of Pulmonary Tuberculosis. Samuel W. Ellsworth, M.D., Boston M. & S. J. 187:472, September 28, 1922.

THE screen serves best in observing the movements of the thorax, diaphragm and heart during respiration. The film or plate gives a permanent record of the details of light and shade. The stereoscopic films afford perspective vision and position of shadows. The lung fields, distended with air, offer but slight resistance to the passage of the rays and present a brilliant background for the study of the more opaque tissues. The depth of the shadows cast is dependent upon the density and mass of the structures traversed by the rays. * * *

"Interpretation of x-ray films demands a careful analysis of the data observed; definite diagnosis or etiology can be made only by a coordination of the history, physical signs and symptoms and laboratory data.

"It is necessary to emphasize that x-ray observations concern not merely one spot of density but rather the entire lung fields, the level of the diaphragm, the excursions during respiration, as well as the position and movements of the heart. * * * Doubtful cases may require repeated examinations."

Mutation of Pulmonary Shadows Due to Type of Breathing. H. A. Bray, M.D., Am. J. Roentgenol., 9:628, October, 1922.

THAT the shadow of any pulmonary type of lesion remains constant and unchanged is questioned by this writer. He maintains that changes in the type and depth of inspiration preparatory to x-ray exposure produce striking shadow mutations.

He has found that "hard" shadows which some roentgenologists interpret as indicative of fibrosis and inactivity may, by a change in type and depth of inspiration, become soft shadows which ordinarily are interpreted as evidence of an active lesion. Regulation of "the extent of participation of the costal and diaphragmatic elements during the inspiratory act" results in numerous transitions in any mutation observed.

The occurrence of these shadows is "especially to be remembered in studies devoted to the correlation of the roentgenography and pathology of tuberculosis."

A Study of the Roentgen Aspect of Tuberculosis of the Joints and Its Relation to the Clinical Aspect, Especially When Under Treatment by Universal Light Baths. Edward Collin, M.D., Copenhagen. Acta Radiologica, 1:395, August, 1922.

THE Finsen Medical Light Institute offered the material upon which this study was based. The author announces that the study is only preliminary. Twelve case histories are detailed and amply illustrated by 35 plates. The following is an abstract of the author's summary: (1) Even though the plate reveals no sign of tuberculous changes the possibility of the affection being tuberculous remains. (2) Changes may become apparent on the plate at a time when clinical symptoms are improved. (3) Even very large destructions may be impaired with treatment by light rays. (4) Complete healing may occur long after clinical symptoms have ceased. (5) Tuberculous ostitis can heal spontaneously but healing is attained more quickly and the cosmetic and roentgenologic aspect is much better if light rays are used. (6) "Simultaneously with clinical improvement considerable roentgenological deterioration is seen at times. In reality this is merely the sign of the diseased material being resorbed. (7) Extensive arthritis in hand, ankle, knee, and elbow joint can heal with new formation of articular cartilage and good function. (8) A joint end seen deformed roentgenologically can occur simultaneously with a completely free function clinically."

Results of Treatament of Surgical Tuberculosis with Carbon Arc-Light Baths at Finsen's Light Institute from 1913 to 1921. N. P. Ernst, Copenhagen. Acta Radiologica, 1:422, August, 1922.

IN Denmark, Norway and Sweden, the author states, this treatment is being employed increasingly with good results. However the results depend upon the proper technique being used and directions are given for this in the original article which covers more than thirty pages and is thus summarized:

"At the Finsen Medical Light Institute in Copenhagen on the initiative of Doctor Reyn 'Finsenbaths' (carbon arc-light baths) have been employed since 1913 for treatment of patients suffering from lupus or surgical tuberculosis.

"In all, 439 patients suffering from surgical tuberculosis have been treated, 158 cases of uncomplicated tuberculosis * * * and 396 cases of tuberculosis complicated with abscess or fistulas. * * * The results with treatment have been remarkably good.

"In 158 cases of uncomplicated tuberculosis in joints and bones 12 have broken off the treatment. Of the rest 122 or 83 per cent were cured (88 with free movement, 18 with partial movement, 5 without movement). Five were improved and only 19 were unchanged.

"In 396 cases of surgical tuberculosis complicated with abscess or fistulas 24 have broken off the treatment and 10 have died under treatment. Of the remaining, 332, or 91 per cent, were cured (255 with free movement, 55 with partial movement and 22 without movement). Fifteen were improved and only 25 were unchanged.

"As regards the results, one may remember that the greater part of the patients are adults, only less than one-third per cent are recruited from childhood, and further many of our patients have been ill for so many years, that *a priori* any thought of recovery had to be excluded. Furthermore it may be remembered that many of our patients on account of lack of space and much against our wish, have had to be treated ambulantly, and during the treatment they have lived in their extensively poor homes.

"The best results are obtained in cases of tuberculosis in hand and foot and elbow joint, also in all forms of ostitis both complicated and uncomplicated.

"The cases which have proved refractory are the uncomplicated tendosynovitis, and the very old fistulous bone affections in columna pelvis and coxa."

Osgood-Schlatter's Disease. Ellie R. Bader, M.D., Am. J. Roentgenol., 9:623, October, 1922.

OSGOOD-SCHLATTER'S disease is due primarily to trauma and its severity varies from a subacute inflammatory thickening of the tibial tubercle to its complete avulsion by muscular contraction.

Anatomical and radiographic description follows the definition of the disease and two cases are discussed and illustrated by x-ray films.

Differential diagnosis must be made from tuberculosis, bursitis, infectious arthritis, fracture of patella, periostitis, joint fringe, and loose cartilage. The x-ray plate is the method of differentiation.

Callus Formation Without Preceding Injury. Walter Mueller, M.D., Muenchen. med. Wchnschr. 69: 1475, October 20, 1922.

DEUTSCHLANDER has observed a number of cases of callus for-

mation with no history of preceding injury. The patients, who were mostly middle aged women, began to complain of localized pain at the junction of the middle and distal thirds of the metatarsus. Roentgenograms were negative at first, but after three to four months a spindle-shaped callus was noted usually on the second, but occasionally on the third or the fourth metatarsal bone. No fracture line could be demonstrated. Deutschlander attributed this structural change to a low grade hematogenous ostitis and he believed there was even some rise of temperature in these cases. Jacobsen and Vogel deny the possibility of callus formation without preceding fracture.

The author of this paper, however, claims that callus may form not only in traumatic and inflammatory conditions, but also whenever the bone has been exposed to insult of long duration, and he substantiates his claim by experimental evidence. A similar spindle-shaped new bone formation was produced in the ulna of a dog within six to seven weeks after resection of a large part of the radius. The new bone deposits occurred just opposite the defect in the radius. The orignal bone tissue in the center of the callus gradually disappeared. Martin first observed this phenomenon manifested in the ulna in cases of pseudo-arthrosis of the radius and he named it "sympathetic disappearance of bone."

A.M.P.

The Definite Form of the Coxa Plana. Henning Waldenstroem, M.D., *Hospital of St. Goeran, Stockholm.* Acta Radiologica, 1:384, August, 1922.

"COXA plana essentialis" is the designation suggested by this writer for what is now called Legg's disease, Perthe's disease, osteochondritis deformans, coxae juvenilis, etc. The first names he objects to because they are the names of individuals and the last because it indicates a symptom (inflammation) which does not belong to this lesion, but to coxa plana tuberculosa, staphylomycotica, etc., from which the roentgen plate does not distinguish it during its early stage of development. A certain observation period throughout its entire development is usually necessary to establish it as a true coxa plana essentialis.

These periods and their roentgenological description are thus given by the author:

(1) Evolutionary period—this lasts from three to four years and has two stages:

(a) The initial stage of one half to one year. The epiphysis is dense with decalcinated spots, flattened, uneven at the margin. The collum often has decalcinated spots just near the upper part of the epiphyseal line. The articular cartilage is of normal height.

(b) The fragmentation stage lasts from two to three years. The epiphysis is extremely flattened and divided. "At the beginning it is often in three large pieces that can afterwards be divided into many small granules. Atrophy."

(2) Healing period. This lasts from one to two years. "The epiphysis becomes homogeneous. The lime returns."

(3) The growing period extends "to the conclusion of the normal period of growth. uring this period the coxa plana assumes its final form."

(4) The definite stage.

SUMMARY

"The diagnosis coxa plana essentialis can with certainty be made only during the evolutionary stage. The definite form can, therefore, only be studied in cases that are followed from the beginning of the disease.

"To endeavor to explain the definite form of coxa plana I have examined those cases of coxa plana where I have been enabled to follow the development from the beginning until the end of the period of growth. There are shown to have been 22 hips; ten of these have attained an age of over 20 years.

"The definite form that I can hereby establish, is shown to be very variable in respect to the degree of the deformity, but the flattening of the caput, collum and acetabulum is common to all.

"Through roentgenograms, both from a frontal and a lateral view, one can obtain a plastic picture of the form of the caput and collum in the different cases. It can then be seen how it is mainly the anterior-superior portion of the caput that is enlarged and that this portion, in the more pronounced cases, lies outside of the articulation. With respect to the degree of the deformity I have divided the definite coxa plana into three groups: (1) The caput preserves a rounded form. The caput and collum can be well distinguished from each other and from the trochanter. (2) The upper and frontal part of the enlarged caput lies close to the greater trochanter. * * * (3) The joint surface of the caput is uneven and more or less excavated. The upper pole of the caput is edge-formed and usually lower than the summit of the greater trochanter."

Seventeen films illustrate the original article.

Bone Sarcoma: Prevalence in Massachusetts. E. A. Codman, M.D., Boston M. & S. J., 187:543, October 12, 1922.

DR. CODMAN'S attempt of the past few months to register all cases of bone sarcoma in the present population of Massachusetts has so far yielded nine authentic cases. Twenty-two cases of giant cell tumors have also been reported.

Dr. Codman reports that the following reports have been brought out by this investigation: "Diagnosis should be made with great caution; Bloodgood's claim of the benign character of giant cell tumors (erroneously called sarcoma) is confirmed by experience in Massachusetts. True osteogenic sarcoma is almost always fatal (the rare exceptions being cases where early amputation is performed). Since only nine living cases could be located in a population of 4,000,000 there are probably only 225 in the whole United States. It certainly is not likely that there are more than double this number at any rate."

He believes that logically the x-ray may be used in a case of suspected bone tumor, for surgery has little chance if the tumor is malignant. and if it is benign delay can do no harm and cure may result from the use of the x-ray.

Editorial comment in the above journal informs us that "a unique collection of material, including histological preparations, x-ray plates, gross specimens and case histories of bone tumors from all parts of the county" have been collected as a result of Dr. Codman's investigation. "The cases of bone sarcoma already collected by Dr. Codman constitute a larger series than most pathologists see in a lifetime."

On the Roentgen Treatment of Brain Tumors. S. Nordentoft, M.D., Acta Radiologica, 1:418, August, 1922.

THIS is "a report of 19 cases of clinically diagnosed tumor of the brain, treated by roentgen irradiation. Probably some of them have been cyst or meningitis serosa, etc., not responding to irradiation. Nine of them seem to be cured (some of them with remaining defects, as, for instance, hemianopsia) and some are surviving: one of them two and one-half, the others from three and one-half to six and one-half years after treatment. Through the good effects of irradiation the diagnosis of brain tumor is confirmed."

High Frequency Practice for Practitioners and Students. By Burton Baker Grover, M.D., Octavo, pp. 398, illus. 95. The Electron Press, 115 East 31st St., Kansas City, Mo. 1922. Cloth, $4.00 net.

DR. GROVER is enthusiastic upon the subject of physiotherapy but his enthusiasm is tempered, as the following sentence, quoted from the preface of this volume, shows:

"Electrical modalities assist in rounding out the physician's armamentarium, but let us not through enthusiasm possess ourselves with the idea that the entire field of medicine revolves about the art of physiotherapy."

The physics of electricity in general, of light and of high frequency currents, with the apparatus for producing the latter, are treated of in the first 63 pages. In the next two chapters medical diathermy and surgical diathermy are defined, their general effects and the technique for their use is described.

The physiology, etiology and interpretation of blood pressure are discussed in the next chapter; the following one classifies pain into its different types and the causes of these are discussed.

A discussion of the diseases amenable to high frequency therapy is given the largest proportion of space in the book. Etiology, symptoms and technique of treatment are fully discussed. Seventy-five or more diseases and disease conditions are named for which this form of therapy is recommended.

There is much new material in this book. Forty pages are devoted to diseases of the eye and their treatment by electricity. The author wishes it definitely understood that for these conditions he is recommending electrical treatment only as an adjunct to established forms of eye therapy, nevertheless, he believes it to be a valuable and at times a very necessary adjunct to the recognized forms of therapy.

The author's address, given as retiring president of the Western Electro-Therapeutic Association in 1921, is given in an appendix to the text proper. In this address are arguments for the adoption of physical methods of therapy by the general medical profession and the progress made by this form of therapy is reviewed.

A glossary, index and questionnaire complete the book.

Dental and Oral Radiography: A Textbook for Students and Practitioners of Dentistry. By James David McCoy, M.S., D.D.S., F.A C.D., Professor of Orthodontia and Radiography, College of Dentistry, University of Southern California. Third Edition. Octavo pp. 197, illus. 116. St. Louis, C. V. Mosby Company, 1922. Cloth, $3.00 net.

THIS, the third edition of this book, is put forth in as condensed a form as the author considered consistent with the object in view, namely, a text of interest primarily to the dental student.

The first chapters have to do with the physics and the early history of x-rays. The historical sketch, while given in a very brief and condensed form, is written in an unusually interesting manner.

The requisities of the dental x-ray laboratory and the technique of dental and oral radiography are then taken up. Intra-oral and extra-oral methods, proper tube and current conditions, correct exposure and development of x-ray plates and films are the specific topics discussed throughout the next 50 pages.

Drs. Baughman, Ebenreiter and C. W. Jones aided in the selection of the 60 films which illustrate 20 pages devoted to a discussion of the interpretation of dental and oral radiograms.

Indications for the use of the x-rays in the following conditions are given: general oral examinations, pericemental infections, root canal treatment, root resection, pyorrhea alveolaris and allied diseases, crown and bridge work, painful reflexes, oral surgery and orthodontia. Radiographic requirements for each of these conditions are given.

The author in his preface to this edition rmarks that the overenthusiasm which marked the early history of dental and oral radiography has given way to more rational views. While dental and oral radiography is absolutely necessary in many instances, it is "but one important link in the chain of successful diagnosis."

Gonorrhea and Impotency: Modern Treatment. By Edwin W. Hirsch, S.B., M.D., with an Additional Lecture on Ultra-Violet Radiation by A. J. Pacini, M.D., 16 mo, pp. 172, illus. 27. The Solar Press, 209 So. State St., Chicago, 1922. Cloth, 3.50 net.

THIS book consists of nine lectures, the topics of which are (1) The Anatomy of the Urogenital Tract (2) Equipment; Solutions; Cleansing of Instruments. (3) Acute Anterior and Posterior Urethritis. Chronic Anterior and Posterior Urethritis. (4) Prophylaxis and Treatment of Acute Gonorrhea. (5) Treatment of Chronic Gonorrhea. (6) Complications of Gonorrhea. (7) Non-Specific Urethritis—Gonorrhea in the Female—Cystitis, Urinary Fever. (8) Impotence and Sterility. (9) Ultra-Violet Radiation.

The young practitioner, says the author, usually has only hazy and indefinite ideas upon the diagnosis and treatment of "the most important of human affections, venereal diseases." Text books do not contain the vital information needed in practice, and so the author has written this book out of his own successful experience in treating these diseases.

He has found physical agents to be of great value in the treatment of gonorrhea and its many complications. He discusses the etiology, pathology, symptoms and treatment of these various complications and where physical agents are advised detailed directions are given as to technique.

The last chapter, upon ultraviolet radiation in urology is a very compact little treatise written by A. J. Pacini, M. D.

There are two pages of colored illustrations, and a number of schemiodiagrammatic drawings which were originated by Eugene F. Carey, M.D.

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Sinus Disease and Lung Infections*

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WHEN we are confronted with any case showing physical signs over the chest or symptoms referred to the lungs our chief differential diagnosis is to determine whether the lesion is tuberculous or non-tuberculous. This has been rendered more difficult by our experience with the influenza and its manifold sequelae, and our army experience, with its vast number of chest cases following gas and various acute infections.

The difficulty has become more apparent chiefly because of the realization of our limitations in a physical examination. Attempting to diagnose a case of incipient pulmonary tuberculosis by its described classical early symptoms and signs will lead any of us into error. If we will from the start regard an incipient tuberculous lesion in the lung simply as a focal infection and attack the differential diagnosis in that light we will go far in overcoming our blunders. Given any case presenting the symptoms of a focal infection, fever, fatigue, malaise, loss of weight, rapid pulse, and add to these cough, occasional spitting of blood, and localized rales over an apex there is nothing a clinician can do but to make a diagnosis of pulmonary tuberculosis. Everything we have learned in physical diagnosis will tell us to make such a diagnosis. In the large majority of cases we will be right, but again and again, if we do not go further in our study of the case we will be wrong. These minority cases are the true trouble makers which worry our minds and by mocking our prognoses injure our reputations with the patient and his kinsfolk.

In reviewing 389 cases studied in the last two years, among such patients referred by able clinicians as tuberculous, we have found 28 per cent of them to be suffering from other foci of infection. And among these non-tuberculous cases the primary focus outside the lungs has, in the vast majority of instances, been the head. So constant has been this observation that in every case presenting a non-tuberculous lung lesion we examine the air sinuses and tonsils for trouble. The work of Dr. W. V. Mullen[1] and Dr. Gerald Webb[2] in Colorado Springs has been a stimulus to such investigation. Some are so dogmatic as to state that "every case of bronchiectasis is accompanied by sinus diseases." We are not fully decided to go that far, but Dr. Dunham has stated that almost every case of this combination of lesions which offers the greatest difficulty in differentiation.

In the 389 cases studied, all gave some combination of the symptoms mentioned and presented physical signs over the chest. The differential chest diagnosis was made by the study of stereoscopic x-ray plates of the chest. After determining that there was no evidence of active pulmonary tuberculosis the active focus was sought by most careful and complete physical and x-ray examinations. Our review of these 389 cases is as follows:

Uncomplicated Pulmonary Tuberculosis		270
Bronchiectasis		25
Secondary to infected antrums	8	
" " " ethmoids	4	
" " " ethmoids and antrums	13	
Apical Catarrh		42
Secondary to infected antrums	16	
" " " ethmoids	3	
" " " ethmoids and antrums	17	
" " " tonsils	3	
" " " teeth	3	
Unresolved Basal Pneumonia		18
Secondary to infected antrums	3	
" " " frontal sinuses	1	
" " " ethmoids	4	
Following Influenza	10	
Inactive pulmonary tuberculosis complicated with active nasal sinus infections		21
Hilum node infections		11
Mitral stenosis		2
Total		389

purulent bronchitis or apical catarrh which has come under his observation has been accompanied by sinus infection. And what is important and interesting is that a diseased sinus can be present with absolutely no symptoms of which the patient is aware referable to the head.

Furthermore, not only is this association of pulmonary lesions and sinus disease to be sought in these cases where the lung condition proves to be definitely non-tuberculous, but given a limited inactive, tuberculous lung lesion found on physical examination one must not be misled into explaining all the patient's complaints by this tuberculous condition. Frequently just such cases are complicated by an acute lesion which produces the symptoms. It is

Confronted with a case showing definite symptoms and signs pointing to a lung infection how are we to attack the differentiation? In almost every case it is a task which calls for every clinical and laboratory test available, but chief and foremost in its value is the x-ray chest picture. But let us emphasize again that in almost every case of such fine differentiation we need the benefit of a complete clinical laboratory investigation.

The reading of an x-ray chest plate is a study for a specialist. Unless the anatomy, pathology and pathogenesis of the disease is accurately understood and applied in the reading, it is of comparatively little help to the clinician.

Before discussing x-ray diagnosis of lung diseases I wish to review and em-

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, December 6, 1922.

phasize such essentials of the anatomy and the pathology of these diseases as are necessary to apply in reading the plate. The division and distribution of the bronchi to each lobe of the lungs has been described and classified.[3]

In the upper lobes we have the first and second interspace trunks, each of which have anterior and posterior divisions. On the left side we have in addition the long branch which runs down into the lingual tip of the upper left lobe. Below the main stem bronchus to the upper lobe, we see the trunk to the middle lobe on the right side, running anteriorly. The branches to the lower lobes all arise from a main stem bronchus and except for anterior and posterior divisions have no special classification. The application of this knowledge is essential in localizing a lesion within the parenchyma of the lung.

The normal lymph flow through the lung, which occurs from the parenchyma toward the hilum, except for a small area which is immediately under the pleura and which may drain into the pleural lymphatics, has a vital bearing on the pathology and progress of the disease.

But of prime importance to the reading of an x-ray chest plate is a thorough understanding of the septa of the lung and their influence on the pathology. Septa are prolongations of the connective tissue from the pleura down into the lung. These connective tissue septa, rich in lymphatics, act as excellent barriers to the spread by continuity of any lung pathology characterized by exudation. Inflammatory exudation starting within any one of these small compartments between two septa, anatomically known as the "secondary lobule" of Miller [4], is definitely limited by these barriers. Spread through such a septum will not take place until cavitation occurs. The localization and restriction of the pathological changes by these septa accounts for our localized rales on physical examination and also explains the "fans".[5] Let me state, however, that these "fans" may be present in any lung disease characterized by exudation. The cellular elements of an acute pneumonia, apical catarrh or an infarct are all held in check by the septa and can consequently give localized signs and a "fan" on an x-ray plate. But the differentiation of these lesions can be made by further study with an understanding of the progressive pathology.

An exudate is the first reaction to the implantation of tubercle bacilli in the tissues of a sensitized individual. If a massive dose has gained entrance at a certain point the exudate is of the polymorphonuclear type, due undoubtedly to the reaction of the tissue to any foreign protein. But this polymorphonuclear exudate disappears in about forty-eight hours, to be replaced by the characteristic mononuclear exudate and endothelial cells. From these elements the characteristic microscopic picture of tubercle formation with giant cells, epitheiloid cells and lymphocytes is produced.

From this point the pathology progresses either to the reparative changes of fibrosis and calcification or the destructive changes of caseation, ulceration and cavitation. When an adult individual is in possession of the ordinary amount of sensitization and resistance any lesion of pulmonary tuberculosis always tends toward healing. It is also true that the lesions of an adult type of pulmonary tuberculosis are the result of repeated infections either from without or within. For instance, the first lesion within the lung of an individual case, let us say, is in the right apex. This particular lesion has gone through the pathological changes of exudation, tubercle formation, and is now present only as an old fibrotic scar. But while this oldest lesion has been moving on toward repair and healing, a newer lesion is developed at some other point lower down in the lung or in the opposite apex. This newer lesion may be the result of a spread from the original lung lesion or a new infection from without. This second lesion, we will say, is only in the state of exudation. Drawing the picture still farther, we may have developed an area of caseous bronchopneumonia in one of the lower lobes. This lesion is usually the result of the aspiration of infectious material from some apical lesion. Now, in this problematical yet typical case there are present three distinct lung lesions, all due to tuberculosis and each one in a different state of pathological change. There is represented exudate, caseation, and fibrosis.

From extensive research it has been established that the densities caused by the pathological changes of pulmonary tuberculosis, and shown on the plate, vary in their quality and degree of density, progressing from the least dense to the heaviest as follows: (1) serous exudate, (2) cellular exudate, (3) fibrosis, (4) caseation, (5) calcification. Given, then, the problematic case cited above or any case of tuberculosis showing two or more progressive lesions, the x-ray picture will be characterized by the densities of different qualities. A thorough study of chest plates with this understanding will enable you to read the changes in terms of actual pathology.

As before stated, any exudate thrown out into the lung tissue will be limited by the septa. Therefore, any lung inflammation with exudation can produce a "fan" shaped, localized density on an x-ray plate. An infarct formed by the outpouring of the blood elements will likewise give a similar density. But given any acute infection or infarct the resultant densities shown on the x-ray plate will all be of the same quality because all the lesions will be existing in the same pathological state.

The lung lesions secondary to a chronic sinus infection may be characterized by localized areas of exudate in the lung. The lesions perhaps located in the apices will give you a perfect clinical picture of incipient pulmonary tuberculosis with fever, cough, expectoration, malaise, loss of weight, blood spitting, etc., together with localized rales over the apical lesions. The x-ray picture may show you definite localized densities, but with two or more densities present they can be seen to be of the same quality. The pathological changes do not follow the progressive changes similar to tuberculosis and so the x-ray picture is different.

In a case of bronchiectasis little or nothing abnormal may be made out on an x-ray plate. Usually the only finding is a noticeable increase in the width of the trunks running to the bases or in a particular area. But even this may be absent. In such a condition the demonstration by the x-ray plate of the absence of tuberculosis, the history, symptoms and sputum analysis, together with possible thickened trunks on the x-ray plate make the diagnosis for us.

Having determined the presence of a non-tuberculous lesion in the lungs, proper handling of the case will then demand x-ray pictures of the sinuses, and, especially, the close cooperation of a competent nose and throat specialist.

Malignant tumors, such as carcinoma or sarcoma in the lungs spread by continuity, with no respect for septa. Consequently there is produced on the x-ray plate, in the greater number of cases, the usual picture of ball-like lesions. Here again the absence of apical lesions and the character of the density helps to differentiate from tuberculosis.

Conclusions

1. The first step in the differential diagnosis of lung diseases is to determine whether the lesion is tuberculous or non-tuberculous.

2. In any case of apical catarrh, purulent bronchitis, bronchiectasis or localized areas of pneumonia, infection in the head or throat should be sought.

3. The symptoms of incipient pulmonary tuberculosis are the symptoms of a focal infection.

4. A properly interpreted x-ray chest plate is the most valuable aid in the differential diagnosis of tuberculous lung

lesions and acute infections secondary to sinus disease.

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Can the Medical and Dental Professions Agree on Any Standardized Treatment of the Focus of Infection*

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THE material presented in this paper has been compiled from about fifty-five replies to a questionnaire sent out to two hundred dentists in various parts of the country. As these men are all well known in their profession their replies may be considered as representative of what dentists are doing today with the problems presented by oral foci of infection in the form of periapical destruction and pyorrheal conditions.

I. (a) WHAT IS YOUR PRESENT OPINION AS TO EXTRACTION IN THE CASE OF A TOOTH THAT SHOWS DEFINITE PERIAPICAL PERICEMENTAL DESTRUCTION?

56% use extraction.
10% favor trying treatment first, but extract at once if treatment fails.
34% favor treatment or are undecided as to procedure.

The answers indicate that in the majority of these last cases the tooth is undoubtedly left in the jaws. It is clear, however, that the trend of good practice at the present time is distinctly toward making sure that the foci of infection are all removed.

But there seems to be no definite standard even among those who favor extraction. Thoma says, "Surgical treatment indicated." Some, like Dotterer, specify, "Extraction and curetting." Root amputation is specified by some, for the six anterior teeth. Chase, New York, makes the condition, "provided the infection is limited to the upper third of the root, and the tooth is firm in its socket." This is a definite statement. But what would you make of another who says, "Extract in cases of illness; use root amputation if the patient is healthy"? Where is the border line between health and illness, and how does the dentist propose to discover it?

*—Read at the Annual Meeting of The Radiological Society of North America, Chicago, Dec. 10, 1921

Dr. Milberry of San Francisco states the general position of those who treat: "The general condition of the patient, tooth or teeth, and surrounding tissues as evidenced by a careful clinical examination and the radiogram, would determine the policy. My general contention is that the conservation of the teeth is the basis of dental practice, beginning with the earliest form of preventive dentistry and continuing throughout life where tooth conservation is not inimical to the physical welfare of the patient." But such a statement does not give a definite procedure. "When tooth conservation is inimical to the welfare of the patient" is exactly what we are trying to discover; and I maintain that a safer practice is shown by the larger group who state briefly, "Extract."

I. (b) WHAT IS YOUR PRESENT OPINION AS TO EXTRACTION IN THE CASE OF A TOOTH THAT SHOWS DEFINITE PERIAPICAL RAREFACTION OR CHRONIC ABSCESS?

48% extract.
40% try treatment first.
12% treat.

The practice in this condition is practically the same as that shown in I (a). It is evident that the best practice at present ends in extraction. But at the same time let us bear in mind those thousands of patients who have not the good fortune to meet with the extracting dentists.

The course pursued by the 40 per cent who try treatment first may be studied in three representative answers. Van Loan of Albany states: "Extraction is better in about 90 per cent. There may be a possible 10 per cent of cases which may, if patient's vitality is favorable, recover by treatment. We think, though, that the percentage would be better 5 instead of 10 per cent." Van Loan by the "we" possibly refers not only to himself, but also to a group of dentists in Albany who are associated in a study club, one of the few signs of any standardizing of practice to be observed in the country.

II. (a) IF YOU BELIEVE IN ROOT CANAL TREATMENT OF THESE TEETH, WHAT METHOD DO YOU RECOMMEND?

Many methods are mentioned, some by name, some vaguely; it would be difficult to classify them. Several dentists gave no answer at all. Howe's method is mentioned specifically by ten dentists; Callahan's by five; Prinz's by two; Rhein's by two. That mild antiseptics are to be used is specified by two dentists only. "Different treatments" not described at all are to be used for "different conditions." *There is one unanimous warning that the canal filling must not extend beyond the apex of the root.* Stillman of New York speaks of "the principles of the accepted methods. They concur, so far as I have been able to learn." Chase of New York observes, "I have little or no faith in ionization."

One cannot but be struck with the divergence of methods and the lack of agreement as to what is the best method in any given case. Novitzky banishes them all with, "There is no possible method which will permanently embalm a dead tooth while one end of the tooth remains in the mouth."

Closely pressing the matter, to discover just when and how the x-ray is used in examination of teeth and in diagnosis, I put the next question thus:

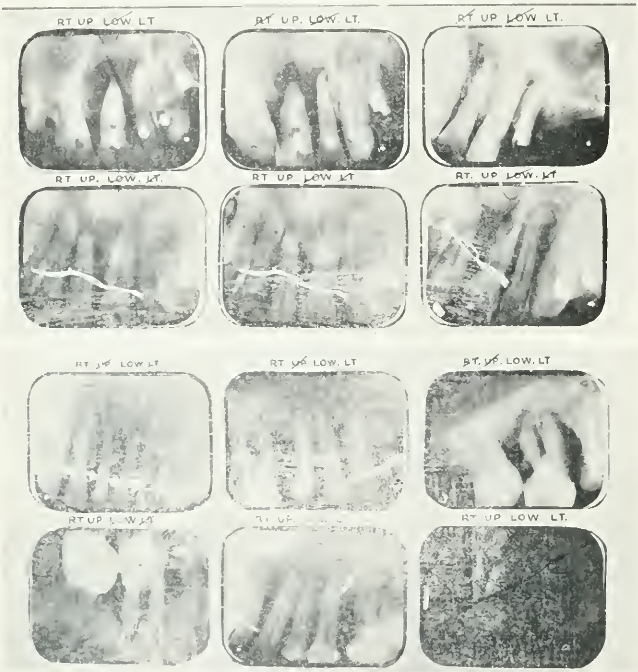
II. (b) WHAT X-RAY APPEARANCE WILL DIFFERENTIATE THOSE FAVORABLE FOR ROOT CANAL THERAPY FROM THOSE TO BE EXTRACTED?

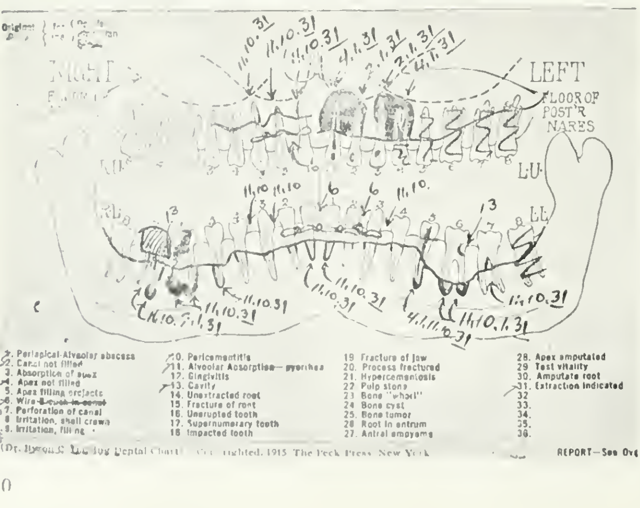
76% use the x-ray for differential diagnosis.
24% say it is impossible to differentiate by means of the x-ray.

Among the latter are men like Novitsky, who hold that all dead teeth call for removal. He says: "The x-ray will not show infection. There is no way of differentiating between dead teeth said to be harmless and those that

are not. They are all infected." Vaughan also says: "I do not think you can depend on the x-ray appearance as to differentiation." These are opinions based on grounds other than indifference to the x-ray, and quite different from that dentist who says: "It is impossible adequately to describe the appearance which may lead to a conclusion."

To return to the majority who use the x-ray for differential diagnosis: Thoma summarizes his findings: "(1) Favorable anatomical conditions. (2) No periapical absorption." Hewitt, Philadelphia, says: "Where the tooth apex projects into a well defined cavity, extract or amputate. Where the rarefaction is beyond the root, and cancellated tissue is evident in translucent area, I sometimes try to treat." Conzett, Dubuque, states: "If there are any rough ends of the root showing in the radiograph, or if the area is diffused and not distinct, its treatment is contra-indicated. And all cases are suspicious that show rarefied areas in case of systemic infection." Merritt of New York discovers by the x-ray "whether the condition of the root is such as will admit of proper root filling. Crooked or malformed roots would indicate that this could not be done." In the practice of Prinz of Philadelphia "If the disturbance is confined to the periapical tissues, treatment under suitable conditions may be indicated. If, more or less, all of the pericementum is involved, the tooth must be extracted."





It is evident that to those men who try treatment of any of the cases we are discussing, the x-ray is indispensable for practical work.

II. (c) WHAT IMPORTANT CLINICAL SYMPTOM OR GUIDE, OTHER THAN THE X-RAY APPEARANCE, WILL ENABLE YOU TO TELL WHICH TEETH WILL GO ON TO REPAIR AND BONE RESTORATION AND WHICH ARE A POSSIBLE SOURCE OF INFECTION?

73% depend on clinical symptoms, general or local.

27% for various reasons *do not* depend upon clinical symptoms.

Of the 27 per cent, 11 per cent state definitely that *there are no clinical symptoms* which may be depended upon. The opinion of Conzett of Dubuque characterizes this group: "I have found nothing to be absolute. Clinical symptoms and data are misleading. You can prove anything by clinical experience, from scientific medicine to patent medicine." Of this group 8 per cent state that there is no *definite* guide; and 8 per cent state either that bone repair is doubtful or that repair is impossible. Potts says that from his experience, "If the infection is cleared up, it may and probably will become re-infected."

Of the 73 per cent who use clinical symptoms as a guide, 43 per cent mention the general health of the patient: 30 per cent mention the general appearance of the gums, etc. Naturally, in practice both of these are used.

The local symptoms to be considered according to Howe of Boston are: "Crepitation, a discharge on pressure, color of tissue, tenderness on tapping the tooth, firmness of tooth attachment, response to heat or cold or electric current, etc." He adds: "Most teeth in a person of ordinary health are as capable of repair as is any other tissue."

All of these symptoms are understandable and discussable. The point is that while they are important, they were always to be observed years before the x-ray was available. However, it took the x-ray to complete the picture of the diseased tooth.

My next question approached the matter from the standpoint of results of treatment:

III. Do You Believe That Where Teeth Show Bone Restoration More or Less Complete in Two or Three Years This Indicates That the Teeth Are No Longer a Possible Source of Infection? Why?

49% "Yes."
38% "No, for infection remains."
13% Answers are vague or not given.

Forty-nine per cent consider that infection has been eliminated if bone restoration has taken place. The reason given is that bone restoration could not take place in the presence of infection. This is a good argument, but it is not scientific; it does not stand the test of the bacteriologist. One must, however, consider the apparently good logic of the men who take the stand of Levy of New York, who says: "If you take as evidence of infective process, the formation of an area of radiolucency, by the same guide the disappearance of the area must be regarded as a removal of the infection." The answer to this is that while it has been proved that radiographic rarefaction is indicative of infection, apparent bone restoration does not mean that normal bone has been formed and all the infection eliminated. A safer assumption of experienced practitioners, as well as of research workers is: "Once diseased, always diseased." While the x-ray will detect the presence of an abnormal condition, it cannot establish that a cure has been effected, when bacteriological examination of such restored areas will show infection still present.

The 38 per cent who say that such restored teeth remain as a source of danger are supported by scientific facts. Without doubt, it is advisable that more research work be done on this subject, but the weight of the evidence at the present time even, is still with the advocates of extraction. From Novitsky comes this statement: "Microscopic examination of bone done at Stanford University in collaboration with Professor Frank E. Blaisdell, Director of the Laboratory of Surgical Pathology, has shown that these regions *are not normal.*" Stillman of New York writes: "New bone growth develops directly upon necrotic areas of bone. See Bancroft's N. Y. work on bone regeneration." Thoma says: "Cultures made from such teeth have been found positive." Hewitt, Philadelphia, finds that "A culture taken from a root canal after extensive medication may show negative, but the periapical tissue may be still infected, and

THE TEETH: The x-ray examination shows a moderate to a considerable degree of alveolar absorption indicating pyorrhea. If the dentist finds this to be active, persistent treatment will be required to check it. The teeth also show a general condition of marginal pericementitis.

Right uppers, Nos. 1, 2 and 3—Wires supporting teeth; alveolar absorption—pyorrhea; pericementitis; extraction is indicated.

Left upper, No. 1—Apex not filled; periapical-alveolar abscess; extraction is indicated.

Left uppers, Nos. 2 and 3—Canal not filled; periapical-alveolar abscess; extraction is indicated.

Left upper No. 4—Apex not filled; periapical-alveolar; extraction is indicated.

Right lower, No. 1—Wire supporting teeth; alveolar absorption—pyorrhea; pericementitis; extraction is indicated.

Right lower, No. 5—Alveolar absorption—pyorrhea; pericementitis; extraction is indicated.

Right lower, No. 6—Cavity; canal not filled; periapical-alveolar abscess; alveolar absorption—pyorrhea; pericementitis; extraction is indicated.

Right lower, No. 7—Alveolar absorption—pyorrhea; pericementitis; canal not filled; periapical-alveolar abscess; extraction is indicated.

Left lower, No. 1—Wire supporting teeth; alveolar absorption—pyorrhea; pericementitis; extraction is indicated.

Left lowers, Nos. 2 and 3—Wire supporting teeth.

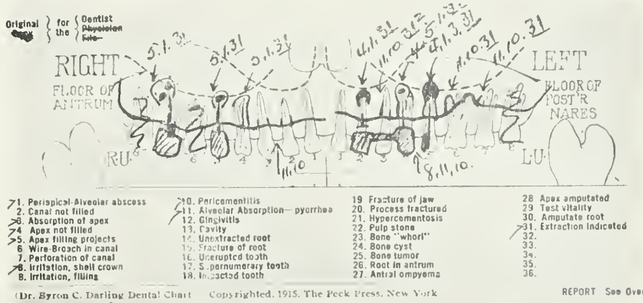
Left lower, No. 5—Apex not filled; periapical-alveolar abscess; alveolar absorption—pyorrhea; pericementitis; extraction is indicated.

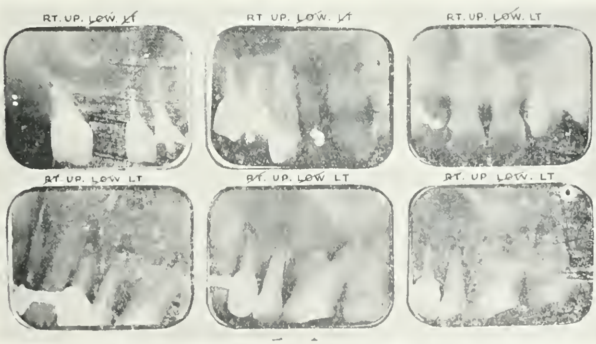
Left lower, No. 6—Cavity; alveolar absorption—pyorrhea; pericementitis; periapical-alveolar abscess; extraction is indicated.

Left lower, No. 7—Alveolar absorption—pyorrhea; pericementitis; extraction is indicated.

(The above is a model of the author's report.)

NOTE—In order to get the greatest benefit from extractions many advice not to extract more than two or three at one time, at intervals of from seven to ten days. Any condition of the teeth at extraction which disproves this interpretation should be communicated to me by the dentist or oral surgeon as of professional interest. The courtesy will be appreciated





THE TEETH: The x-ray examination shows a considerable degree of alveolar absorption indicating pyorrhea. If the dentist finds this to be active, persistent treatment will be required to check it. The teeth also show a general condition of marginal pericementitis.

Right uppers, Nos. 4, 5 and 7—Apex filling projects; periapical-alveolar abscess; extraction is indicated.

Left upper No. 2—Apex not filled; periapical-alveolar abscess; extraction is indicated.

Left upper No. 3—Alveolar absorption—pyorrhea; pericementitis; extraction should be considered.

Left upper No. 4—Irritation, shell crown; alveolar absorption—pyorrhea; pericementitis; apex not filled; apex filling projects; periapical-alveolar abscess; extraction is indicated.

Left upper No. 5—Apex not filled; periapical-alveolar abscess; absorption of apex; extraction is indicated.

Left uppers, Nos. 6 and 7—Alveolar absorption—pyorrhea; pericementitis; extraction is indicated.

(The above is a model of the author's report.)

NOTE—In order to get the greatest benefit from extractions many advise not to extract more than two or three at one time, at intervals of from seven to ten days. Any condition of the teeth at extraction which disproves this interpretation should be communicated to me by the dentist or oral surgeon as of professional interest. The courtesy will be appreciated.

will re-infect the tissue adjacent to the apex."

IV. (a) IS THERE ANY WORKING BASIS IN YOUR LOCALITY? IF SO, BRIEFLY, WHAT IS IT?

About Minneapolis, Best reports: "Would hesitate to say that any working basis has been agreed upon. However, general practice here is along the line of surgical removal of apical infection, opposed to devitalization of teeth, still seeking light on other problems relative to pulpless teeth. Tendency to be conservative."

From Albany, Van Loan reports: "I would say that there is coming to be a working basis among the members of our study club. Outside of that, I believe that the procedure is entirely empirical and individualistic."

Carney of New York says: "Only with the men with whom I am working. Extraction of all non-vital teeth, showing periapical absorption, whenever a general systemic symptom is present."

One practitioner, outside New York City, says: "Too much agreement is to get all the money possible."

All of this amounts to saying that generally speaking there is no working basis in the country.

IV. (b) DOES EACH DENTIST WORK IT OUT FOR HIMSELF ON THE BASIS OF ROOT CANAL TREATMENT, IF POSSIBLE WITHHOLDING EXTRACTION?

54% said that the dentist worked out each case for himself; that there was no settled procedure.

39% did not reply or said they did not know.

13% distinguished what they thought might be considered a tendency to an agreed practice, but it is more a tendency than an agreement.

To show what the tendency to agreed practice is, I quote from Marshall, San Francisco: "Apparently the dentist does not work out each case separately, but on the contrary, adheres to a radical treatment." Howe, Boston: "They are pretty apt to extract at the present time." Van Loan indicates that among his group at Albany, the procedure generally is to try one or two treatments, but if there is no sign of result, extract. For Milwaukee, Banshaf mentions the "Buckley method." Henahan, Cleveland, digresses to remark: "Dentists, the majority, the world over, hold off extraction not because of judgment, but because of sentiment." Novitsky reports only a few exceptions are agreed.

So much for what is being done towards a standardized practice, or rather, what is not being done. Now for the future, I put the next question:

V. HOW WOULD *YOU* DEFINE OR STANDARDIZE THE DENTAL ATTITUDE IN THIS MATTER SO THAT THE MEDICAL AND DENTAL PROFESSIONS CAN UNDERSTAND EACH OTHER?

The answers vary from that of the man who says: "The matter is distinctly a dental topic," to that of the man who says: "Dentists don't know enough to work out the problem." Please remember that these are dentists who are speaking, not medical men. Consider three statements as to standardization: "Impossible at this time." "Dentists are desirous of consulting with physicians in these matters, but object to dictation from the medical profession when it comes to extraction of teeth." Hinman, Atlanta, says: "Let each understand the other's language. Physicians and dentists should stop calling pulpless teeth 'dead.' *They are emphatically not.*"

So much for these opinions. Now consider the opposite, from a dentist who says: "The problems that confront the dental profession can not be worked out by the dentist of the day." Hyatt says: "I am interested in some research work whereby we hope to offer a standardized procedure." Gardner of Scranton thinks: "A standardized system should be suggested by medical and dental societies." Garney of New York recommends: "A conference between a committee from the County Medical Society and the First District Dental Society for this immediate vicinity."

The connection between oral infection and systemic conditions having been once established, as it has been established to the satisfaction of the mentality of even the average layman, it would seem to be incumbent upon us to establish a procedure that would allow the professions to function adequately in logical cooperation in the service of the public.

To turn to another condition in which foci of infection and systemic disturbances are involved—pyorrhea.

VI. IN PYORRHEA, WHAT AMOUNT OF ALVEOLAR DESTRUCTION INDICATES EXTRACTION?

After carefully considering the replies to this question, it is possible to conclude that probably 50 per cent of practitioners at the present time extract when, and not until, the tooth no longer functions as a tooth; but this is a deduction from the replies rather than an exact calculation.

Eleven per cent would agree with Hutchinson, New York: "No amount of alveolar destruction indicates extraction. The retention or loss of a tooth depends on a multitude of other factors."

Three per cent, like Stillman, would say: "This cannot be determined from a radiograph."

Thirty-five per cent cannot *state briefly* the conditions of diagnosis. Of these, two may be quoted as characteristic: Howe of Boston says: "I think a dentist of experience could readily tell, and I should not know how to indicate it in a short sentence." Best of Minneapolis declares: "Impossible to answer this question in a general way, as the diagnosis might be different in different cases. For instance, to make the statement that teeth should be retained if half the alveolar support is left, and extracted if less than half this amount is left, means nothing from a diagnostic standpoint."

Eighteen per cent specify the fraction only, varying from one-third to two-thirds of the root; of these 12 per cent would extract if the destruction involved half or more than half of the root.

Thirty-three stress the importance of considering the mechanical condition of the tooth. Characteristic practice is indicated by quotations from a few replies. Prinz of Philadelphia extracts "If less than a third of the root is imbedded in bone, and there is sufficient loosening of the tooth, principally in a mesiodistal direction."

In the opinion of Novitsky: "In molars, if recession has exposed the root bifurcation, the condition is hopeless. Food impaction and the impossibility of keeping these places clean indicates tooth extraction. In other teeth, if process absorption or socket enlargement is so great as to allow excessive motion of the teeth in their sockets, tooth removal may be indicated. Scaling, temporary immobilization with splints, and the relieving of occlusal stress followed by the removal of neighboring dead teeth often holds out hope of improvement. Judging from the teeth that I have seen, that were treated by some dentists, it would be better to err on the side of removal than on the so-called conservative side."

So much for extraction to remove the infection indicated by pyorrhea. The conclusion is inevitable that prolonged and expensive treatment is often used to the detriment of the patient's general health.

VII. (a) WHICH IS SOUNDER PROFESSIONALLY FOR HIS DIAGNOSTIC SURVEY, TO HAVE THE AVERAGE DENTIST CONSULT WITH A MEDICAL OR DENTAL ROENTGENOLOGIST, OR DO ALL HIS OWN X-RAY WORK AND INTERPRETATION?

58% consult.

42% do their own x-ray work, or their own interpretation, generally both.

The feeling that in order to know the angles each dentist must expose every film himself is a misapprehension.

Every tooth should be taken from two or three, or even more, angles, and the films overlapping confuse the matter so that no one can tell five minutes afterward, except in a general way, just how any one tooth was taken. The ambitious attempt of some to run mathematical lines and angles is only a passing phase. The underlying idea is to get a composite diagnostic interpretation of the condition about each tooth and apply it to the clinical examination.

VII. (b) WILL THE PUBLIC AS WELL AS THE MEDICAL AND DENTAL PROFESSIONS BE BENEFITED BY A SHARING OF THE RESPONSIBILITY BY CONSULTATION?

76% consult.

24% for one reason or another, see no use in consultation.

Extraction being the only proper procedure in the opinion of a small number, no consultation therefore is needed. Some say, "Sometimes, but rarely;" others, "When systemic disturbances are involved consultation is advisable; if the teeth only are involved, the dentist alone should decide." This brings us back to where we started: Where does the dentist stop and the medical man begin? In this connection one might point out that while dentistry might be logically considered a division of medicine, general internal medicine cannot be considered as a department of dentistry, and dentists should avoid seeming to assume the responsibilities of the medical diagnostician.

PRESENT DENTAL PRACTICE REGARDING FOCUS OF INFECTION SUMMARIZED

I. (a) Periapical pericemental destruction: 56 per cent extract; 10 per cent treat first; 34 per cent save.

I. (b) Periapical rarefaction or chronic abscess: 48 per cent extract; 40 per cent treat first; 12 per cent save.

II. (a) Method for root canal treatment: too great a divergence of methods to attempt of classification.

II. (b) Using x-ray for differential diagnosis, 76 per cent; not using x-ray, 24 per cent.

II. (c) Using clinical symptoms, 73 per cent; not depending on clinical symptoms, 27 per cent.

III. Bone restoration: 38 per cent believe infection remains; 13 per cent undecided; 49 per cent, infection cured.

IV. (a) There is no agreed working basis in the country.

IV. (b) Dentist working out each case himself, 54 per cent; slight tendency to an agreed practice, 13 per cent; uncertain, 33 per cent.

V. Majority believe that it is impossible to standardize the dental attitude at the present time; some offer the hope and suggestions.

VI. No definite standard as to what amount of alveolar destruction indicates extraction. The amount of loss of process indicating extraction varies from one-third to one-half to two-thirds.

VII. (a) Dentists doing own x-ray work, 42 per cent; favoring consultation with medical or dental roentgenologist, 58 per cent.

VII. (b) Unwilling to consult with medical profession, 24 per cent; willing to consult, 76 per cent.

In conclusion I wish to thank those who have made this paper possible by so frankly writing their opinions regarding the subjects under discussion. Even when we disagree, when we believe that they are wrong, nevertheless, as medical men, we are under deep obligation to them for the cooperation which has enabled us to take this "bird's eye" view of the general practice of dentistry throughout the country at large.

As a standard practice (for as dentists and physicians, and public we need one), I wish to recommend to you once more the principles expressed by Dr. Clarence J. Grieves in the Journal of the National Dental Association for April, 1921.

The Radiograph: "In all data submitted, the radiograph and its interpretation is a determining factor. While open to criticism, which will be discussed later, the radiograph, within clinical limitations, is the means by which the extensive occurrence of such lesions was first definitely discovered, not only about teeth, but in many other organs. It is still accepted as a most valuable diagnostic adjunct by the surgeon, so this is hardly the time for dentists to quibble over it." (1)

Indispensability of Radiograph: "The radiograph taken and developed according to the latest technique by those familiar with facial and dental anatomy, in form generally of intraoral films, sometimes extraoral plates, is simply indispensable." (2) "Serious pararadicular disease is occasionally masked by roots paralleled or superimposed on the film; but periapical rarefaction, occurring around the apex, is always visible and diagnostic of a dead apex about which the apical bone can never form, for it is negatively chemotactile." (2)

Differential Diagnosis: "How are we to distinguish between the periapically diseased tooth, where this has resulted in the subapical tissues, in touch with the blood stream (Class VI), and the apically well-filled pulpless tooth, where it has not occurred (Class V)? The answer lies in correct diagnosis of the apical disease, defining the normality of the attaching tissues, namely, cementum, periodontal membrane and alveoli; all equally as important, if not more than the pulp. (1)

"Principal among the clinical bony land-marks stands the character and stability of that hard lining of each alveolar socket known as the *lamina dura.*" (2)

Lamina Dura—its destruction is evidence of pericementitis and definite infection. "If the cells of these tissues lie in physiologic apical contact, attaching a well filled tooth from which the pulp has been removed, that tooth is healthy, no matter whether it be called a 'non-vital,' 'pulpless' or 'dead' tooth. (3) When this contact is broken, periapical infection exists beyond the tooth and can best be diagnosed by radiographic study, modified by clinical symptoms. (1)

"Its disappearance in areas, particularly in middle and apical-thirds, with thickening of the dark line representing the periodontium (pericementitis) indicates undue stress or proliferating periodonitis. (2)

Lack of continuity in the lamina is undoubtedly a most valuable symptom of infection advancing beyond the tooth; and, clinically, if it be intact, the cementum should be considered healthy." (2)

Proper Root Canal Treatment: "If pulps can be removed under as nearly aseptic conditions as possible, by careful chemico-mechanical instrumentation, leaving only inaccessible vessels and vital pulp-shreds in the immediate foraminal openings of a vital apex, which has not been cauterized nor oversterilized; or, if these strong agents can be used without their passing out into the membrane (though conservative operators prefer milder medicaments) —if all this can be accomplished without perforation and encapsulation, avoiding infection from debris, then any canal-filling method, as nearly aseptic as can be, that will close these openings well into, but not through the apex, will insure apices infected as little, and filled as much as possible, and also functional teeth." (2)

Bone Repair as Evidence of Cure is Rare: "Bone repair and sclerosis may occasionally be present as dense as cortical bone, but the trabeculae and partitions of the adjacent normal bone, to which these should be compared, are missing." (2) "Sequestra occasionally seem more radiopaque than normal bone and rarefactions may result systemically from osteoporosis, osteomalacia, pregnancy, or calcic waste; in fact, many unusual factors may, but rarely do, appear. * * * Exceptional cases cannot

be compared with the usual, and should not be quoted, disturbing confidence of honest operators seeking help, nor can they be used by dishonest operators seeking an excuse." (2)

"A cure of periapical disease may be defined as regeneration of the lamina dura and associated trabeculae, comparable to adjacent areas on vital teeth or other operated areas, following extraction and curettement. Such repair is indeed rare." (1)

Extract All Infected Teeth Showing Definite Periapical Disease: "There is little use in consuming time for a consideration of the teeth of Class VI (infected teeth, septic pulp, involved by periapical disease). They have been much discussed in former papers (2, 4, 5, 6, 7) and are really not worth while, for the reason that no adequate treatment is known which will certainly cure the suppurative, granulating, or cystic phases of apical disease, except surgery. (1)

"Any treatment of this latter type seldom succeeds; subapical bone may appear as if repaired, but soon breaks down, invading a larger area. (1)

"If there be the slightest question, it is better to err radically, and remove a doubtful tooth, than to risk inevitable damage to adjacent teeth, attaching tissues, or the maxillae and possibly the patient's health. (1)

"From an entire *pyorrhetic* denture, undermined and swaying in purulence, to a single locked periapical area walled off by condensing ostitis or sclerosis, Nature's best protective procedure, is a far cry in pathology; and yet we know the former may do less systemic harm than the latter; just as the hypertrophic pus tonsil may not be a focal factor, while the apparently normal tonsil, with its virulent crypt, may be most active." (1)

The Dentist Should Not Assume Medical Responsibilities: "The dentist, who without medical assistance of the highest order, attempts to distinguish between the sick and well patient, and who presumes by a glance and a few routine questions to determine, instantly, matters which might keep hospital laboratories busy for days, dabbles superficially in internal medicine, when he does not know the actual etiology of or sure treatment for a single dental disease." (1)

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Radium In Sarcoma*

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IN CERTAIN malignant conditions radium has established itself as a specific agent. While we can never promise a cure in the treatment of any disease, the results which have been obtained in the radium treatment of rodent ulcer and early epithelioma of the skin have been so gratifying that we can almost guarantee results. The great requisite is to receive these cases early. An initial treatment is usually sufficient to produce disappearance of the local trouble and one seldom meets with a recurrence.

Unfortunately, however, such uniformity cannot be reported as the result of the radium treatment of sarcoma. fact that, as a general rule, sarcoma develops so quickly and metastases follow with such startling rapidity that the disease is far advanced before the patient appears for treatment. Then, too, although a local condition is often relieved and may be caused to disappear, the danger of metastatic development remains imminent.

The opinions of various therapists as to the value of radium in sarcoma are somewhat varied. According to the report of the London Radium Institute for 1918, radium acts on sarcoma in the following manner: "These growths being extremely vascular, necrotic changes are not so likely to occur as in the case of epitheliomata, and the stimulant action of the radium rays upon the tissue fibroblasts results in the production of much new fibrous tissue, which invades the sarcomatous masses of cells, compressing them and causing their degeneration, the tumor ultimately becoming converted into a greatly diminished dense fibrous mass." That is to say, the tumor has been transformed from a malignant to a benign neoplasm (fibroma). The fibroma, moreover, does not tend to increase in size as is usually the case even with benign growths, but to remain stationary, or to actually diminish in size.

Morson[1] has found that round-cell sarcoma is most sensitive to irradiation, that the immediate results are most encouraging, although metastases are not prevented. He considers spindle-cell sarcoma amenable if it is not growing in bone tissue, but periosteal and endosteal sarcoma more resistant. In some cases of chondro-sarcoma he has seen marked improvement, but melanotic cases give unfavorable ultimate results. Bowing[2] agrees with the view that round-cell sarcoma responds very readily and melanotic sarcoma very poorly to radium and x-ray therapy. He also claims that spindle-cell and giant-cell sarcomas respond more favorably than the melanotic type. This view is somewhat modified in the report of the Manchester Radium Institute for 1921, which states that spindle-cell sarcoma reacts very sluggishly to radium, and that prolonged, not too violent treatment over a long period is necessary. The report goes on to state, however, that they repay the trouble taken, for the prospect of cure is much greater than in the case of the small round-celled type, which, under radium treatment, seems to melt away locally, but subsequently recurs. A similar opinion is expressed in the report of the London Institute for 1919. In this report prognosis is considered better in spindle-celled than in the small round-celled variety, the large round-celled type occupying an intermediate position. Abbe[3] is very enthusiastic in his reports of the effect of the treatment of myeloid and round-cell sarcoma of the jaw and skull, but he finds that the spindle-celled type is not improved by radiation. One case of myeloid sarcoma of the jaw which he describes[4] is particularly interesting as it was first treated in 1904, when radium therapy was in its infancy, and it was reported in 1914 as being still

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, December 8th, 1922.

clinically cured. He also reports a case of a mixed giant-cell and spindle-cell sarcoma of the humerus which showed very marked improvement. Results obtained in the treatment of osteosarcoma are varied. Of this type Skinner[5] says: "Osteosarcoma of the maxillae and the antrum of Highmore lend themselves to a combination of surgery and radiotherapy. It seems difficult to impress surgeons with the ability of radiotherapy to influence sarcomatous tissue. For years we have been able to show results in osteosarcomas with radiant energy as a primary treatment." In speaking of osteochondroma he sounds a warning which is most timely, and might, perhaps, be heeded in the treatment of many other types, when he says: "It is necessary to ray these cases vigorously and for a period of six months after there are no signs of the recurrences left."

In the treatment of lymphosarcoma Skinner considers radiotherapy almost a specific remedy, provided the case comes for treatment while it is still a boggy mass and while the patient is still in good health. Pinch, in the report of the London Radium Institute for 1919, is more guarded regarding ultimate results. He admits that for a period of from four to six months after treatment there is marked improvement, that there generally follows recrudescence, necessitating further exposures, which may have to be repeated at varying intervals over three or four years, that these hold the disease in check, but that there comes a time when the response to radium is negligible, and the disease soon assumes the mastery. Simpson[6] finds lymphosarcoma sensitive to treatment. He considers it one of the most gratifying of all growths in its response to radium. The Manchester Radium Institute report for 1921 cites two cases of lymphosarcoma which have been alive and well between three and four years. This report states that the immediate results of radium treatment are often brilliant, but usually the disease spreads elsewhere and eventually kills the patient.

Speaking of various types of sarcomas and their response to radium, Simpson says: "Sarcoma of the skin usually responds to radium treatment; periosteal sarcoma is frequently benefited; sarcoma of the tonsil and postnasal space are, as a rule, amenable to radium treatment." This is corroborated by the report of the Manchester Radium Institute above referred to, and the reports of the London Radium Institute for 1918 and 1919. "Sarcoma of the orbital tissue recurring after operation is often benefited by radium; cases of mediastinal tumor have received great benefit from radium." Skinner holds that in epulis the postoperative use of radium is the best sort of insurance against recurrence, and, as glandular metastasis is not encountered in this condition, he points out that radiation may be limited to the original site of the lesion.

Melanotic sarcoma often responds most miraculously to treatment, but with radiation, as with any form of treatment, there always remains the constant danger of metastatic development and a fatal termination.

In the treatment of sarcoma it is essential to avoid, if at all possible, any breaking of the investing skin, for, if such should occur, it involves the possibility of hemorrhage and septic infection. It is often difficult, therefore, to obtain tissue for examination and consequently most of my diagnoses have been based entirely on clinical evidence. The treatment I have generally employed makes use of the gamma rays of radium. Flat applicators containing from five to ten milligrams of radium are applied over the mass, the dose varying in intensity in proportion to the extent and location of the lesion. In superficial sarcoma, however, e.g., conjunctiva, finger, skin, etc., beta rays are used. I have had little experience with the insertion of needles. Certain cases have been benefited; others showed little improvement; on the whole, at the present time, I am inclined to favor the use of surface applications only.

A number of the cases I shall subsequently report are very discouraging. A good many of these, however, came to me over ten years ago, when my knowledge as to the powers and limitations of radium was meager, and the result was that very often dosage was wrongly estimated and mistakes were made as to the type of case to choose for treatment. Often, too, cases are referred to me when all other possible methods have been tried. In such cases, if radium is used, it is with the understanding that such treatment can be only palliative.

The following is a summary of the sarcoma cases which I have treated:

Lymphosarcoma

My experience with lymphosarcoma has not been as encouraging as that cited above. I have found this type, as a general thing, most resistant to radiation. In many instances a microscopical examination could not be made, but of those which I knew definitely to be lymphosarcoma, three showed no improvement, two discontinued treatment, one has been held in check for three years, and one is quite cured. Of sarcoma of the neck and parotid I have had thirteen cases. Eight of these were too far advanced to hope for improvement, three were held in check for periods of two, three and four years, and two were cured.

Osteosarcoma

In osteosarcoma the results which I have obtained have been much more discouraging than those above referred to. Sarcoma of the hard palate was treated in five cases. Two were held in check, one for two years, and one for three years, one was cured, and two have not been followed up. One case of sarcoma of the upper arm gave a very striking result. This was a girl twenty years of age, with a growth on the inner aspect of the right upper arm, of six months' duration. Amputation was advised, but she refused. I referred her to a surgeon, who removed the mass and found that the tumor was periosteal, and that bone tissue was not involved. The operation was followed by radium exposures, the radium being buried in the wound, and also applied over the surface. This case was treated in 1916 and there has been no recurrence. In September of last year I treated a case of sarcoma of the upper sternum, of four months' duration, slowly increasing. A very heavy radiation was given, as a result of which the mass disappeared and there has been no recurrence since. These are outstanding cases. Many which come to me, however, have involved the bony structures and such cases have not responded favorably to treatment. Of twenty-two cases of osteosarcoma, eleven were far advanced and gave poor results, three were clinically cured, three discontinued treatment, and five showed improvement, but the disease ultimately gained control. One case of chondrosarcoma has been treated, but the result was poor.

Epulis

The effect of radium in this condition is all that one could wish. This is one type in which there seems to be unanimity of opinion. I have treated seven cases, and there has been no recurrence over periods varying from three months to seven years. This form, of course, does not metastasize, but there has been no tendency to local recurrence.

Melanotic Sarcoma

This condition is a precarious one to treat. Very often the local condition is entirely cured, but treatment is followed by metastases. In a general way, it is wiser not to interfere with melanotic spots until some activity presents itself, and renders the condition dangerous. My results have not been as discouraging as those quoted above. Of five cases treated, one showed no improvement, but metastasized rapidly, three remained clinically cured with no

stases, and one discontinued treat-
.

ANGIOSARCOMA

our cases of this condition have treated by me: one of the arm, one ne neck, one of the bridge of the , and one of the ear. All did ex onally well, and have not recur-

SARCOMA

inger: I have had six cases of this lition and the results have been uni- ıly satisfactory. They have re- ıed cured for periods ranging from to seven years.

onjunctiva: Some of my best re- have been obtained in sarcoma of conjunctiva. I have had four cases l. One discontinued treatment and other three have remained cured for three years. Two of the latter been advised that removal of the was imperative.

rbit: I have had five cases of sar- a of the orbit. Two were far ad- ed and derived no benefit, one discontinued treatment, one received postoperative radiation over the temple, the orbit having been removed, two were clinically cured, and are among my best results. One of these was treated in 1911 and was in excellent condition in June of this year. The other was treated in 1915 and showed no signs of recurrence when she reported to me this month. When she first came for treatment her doctor expected that she would not live more than six months.

Eyelid: Of six cases of sarcoma of the eyelid, one did not improve, one is still under observation, and four are now clinically cured after more than two years.

Nose: In two cases of sarcoma of the nose the patients were clinically cured by radiation, and one did not improve.

Two cases of adenosarcoma, one of the ovary, and one of the neck, showed little improvement. Cases of sarcoma of the larynx, breast, uterus, ovary and spinal cord derived little benefit, whereas certain cases of the temple, cheek, cutis, scalp and lip have been clinically cured. Two cases of sarcoma of the thigh were held in check for three and five years respectively. One of the groin and one of the foot gave poor results ultimately.

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Bone Tumors: Sarcoma, Periosteal Group, Sclerosing Type, Osteogenic, Methods of Diagnosis and Treatment*

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VISH to report somewhat in detail n example of this type of bone sar- a, in order to illustrate the methods liagnosis and attack in this type of oma.

n a recent number[1] of this Journal, report on polycystic ostitis fibrosa, ıriety of the bone cyst, I described method of attack on central bone ors. In *Minnesota Medicine*[2] I dis- ed briefly the differential diagnosis central tumors of bone and their tment.

This very recent observation of an mple of the periosteal group of sar- ıa of bone allows me to discuss the gnosis and what seems the best treat- ıt, based upon our experience up to e.

PERIOSTEAL SARCOMA

Ewing[3] classifies osteogenic sarcoma the following four groups:

Periosteal (extraperiosteal)
Solid medullary and subperiosteal
Telangiectatic
Sclerosing

It is important to remember that en a lesion of bone comes under ob- vation we cannot always diagnose or place it in a pathological group. We can take and record a clinical history, we can make all the laboratory investigations including the x-rays, and then we can palpate. With these data at hand and recorded, it is essential to come to some conclusion as to what method of attack will give the best assurance of a permanent cure with the least mutilation. We must also bear in mind that amputation should be done without delay if the evidence indicates that this procedure offers this assurance.

From my personal studies I find it most convenient and helpful to divide lesions of bone into two great groups based upon the x-ray picture, namely, central and periosteal lesions.

In central lesions the x-ray shows a bone shell with a central light area, and on palpation one feels the bone shell and no evidence of infiltration into the soft parts.

In the periosteal lesion one can palpate a soft-part tumor which may contain no bone or little or much bone, and in the x-ray one can see a soft-part shadow with or without bone formation resting upon a shaft which may or may not show changes of bone destruction or bone formation.

When the x-ray shows a definite periosteal lesion in which sarcoma cannot be excluded the method of attack depends upon the personal view of the one responsible for deciding whether he prefers to try x-ray and radium first, because, if this is his decision there is no indication for an exploration to decide if possible the nature of the pathological process. If the lesion is inflammatory, the delay from x-ray or radium treatment can do no harm. However, if it is the view that resection or amputation should be the method of attack, delay even with x-ray and radium treatment may diminish rather than increase the probabilities of a cure.

The first object of the exploration in the periosteal group of bone sarcomas is to determine by naked eye inspection of the diseased area and the immediate frozen section, whether the lesion is benign or malignant. In view of the fact that the number of cures of periosteal sarcoma after amputation is relatively small, the amputation should not be performed unless the diagnosis at this exploratory incision is as certain as it is possible to make it.

I will first describe in detail a case which allows one to picture a logical and philosophical study of what the definite procedure should be, as based upon the evidence revealed as the study of the case continues up to and including the frozen section.

Pathol. No. 31698—Periosteal sclerosing osteogenic sarcoma of the upper end of the tibia in a white girl aged 16 with symptoms of pain and

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slight swelling of about three months' duration. (Figs. 3 and 4).

The x-rays and history of this case were brought to my attention November 26, 1922, by Dr. Robert B. Greenough of Boston. The child, aged 16, in apparently perfect health, without a definite history of trauma, observed pain in the region of the upper end of the left tibia on the medial side. This was early in September, almost three months before I saw her. There was no fever, or leukocytosis. The pain was at first intermittent, and did not interfere with function or athletics, nor did it give any particular anxiety to the patient or her family. We should stop here and emphasize the fact that *localized pain in the region of a joint or bone should be looked upon with anxiety and should be followed at once by an x-ray, which should include not only the involved area of pain, but the corresponding bone or joint.* We should constantly preach this to the public and practice what, as members of the medical profession, we preach.

The first x-ray was taken November 1, 1922. At this time the child had enough pain to prevent her from taking part in any athletic game. In the region of the inner half of the left tibia there was tenderness and a slight soft periosteal swelling without involvement of the joint and without restriction of motion in the joint. Figures 1 and 2 are anteroposterior views of both knees, taken November 1, 1922, two months after the onset of pain. I will describe what I see in these x-rays.

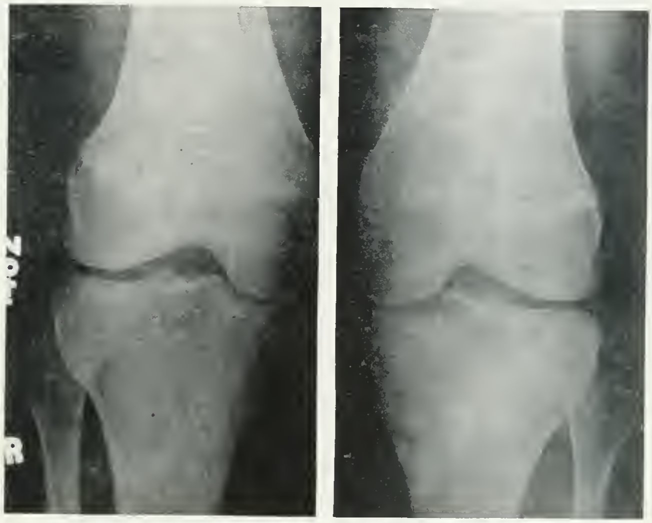
The most striking feature is evidence of a little new bone formation on the medial side of the upper end of the left tibia about 1.5 cm. beneath the joint, and over this area a definite thickening of the soft parts, and I am told that over this area there could be palpated a slight tender soft-part swelling. I can also see a somewhat wedge-shaped area occupying the inner head of the tibia, its base towards the periosteal growth in which the normal architecture of the cancellous bone is blurred by a cloudy defect. This means that there is either a periosteal growth of tissue, or an infiltration in the cancellous bone. In my experience this x-ray picture is more often seen in sclerosing sarcoma than in any inflammatory lesion and until recently we never had an opportunity to observe an early picture such as this.

A number of radiologists and surgeons saw this picture, and apparently the opinion of all favored a diagnosis of a low grade of osteomyelitis or tuberculosis. I have before me the typewritten copy of a number of examinations and interpretations of this case. Every examination was negative, except for this change in the x-ray, and the palpation of the soft, tender swelling, as noted above.

The lateral views, made November 1st, show no evidence of periosteal bone formation, but only the slight cloudy defect of the upper end of the tibia.

Treatment November 1, 1922: In view of the conclusion that the lesion was inflammatory—a low-grade osteomyelitis or tuberculosis—the limb was fixed in plaster and the patient allowed to walk on crutches without weight-bearing. There was little or no improvement in the pain.

Second x-ray, November 20, 1922: Figures 3 and 4 show the anteroposterior views. The interval between the x-rays of Figures 1 and 2 is nineteen days. The soft-part tumor over the inner head of the tibia is a little larger. There is a little more periosteal bone formation. There is no gross destruction of the cortical layer. The cloudy defect of the inner head



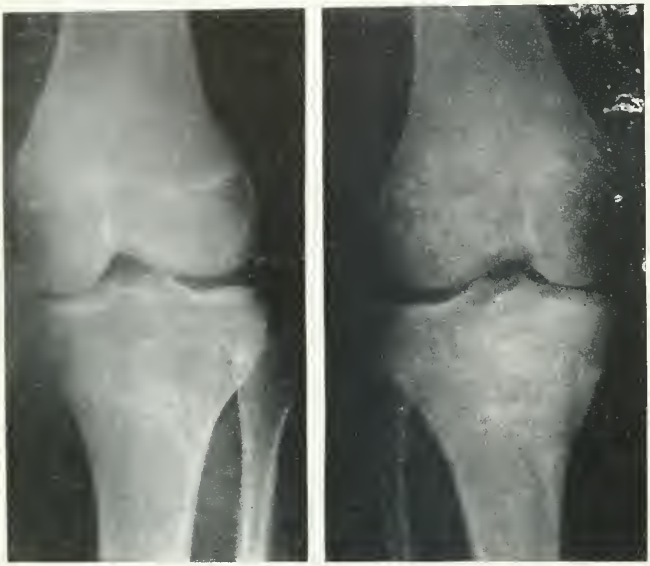
Figs. 1 and 2—(Pathol. No. 31698)—(B. T. 9)—Fig. 1, the right normal knee. Fig. 2, the left, showing the sclerosing sarcoma upper end of tibia, internal side. X-rays taken November 1, 1922.

Figs. 3 and 4—(Pathol. No. 31698)—(B. T. 9)—Fig. 3 right normal side. Fig. 4, left diseased side, sclerosing sarcoma upper end of tibia internal head. X-rays taken November 20, 1922, nineteen days after Figures 1 and 2. The soft-part periosteal tumor is a little larger; there is more periosteal bone formation; the cloudy sclerosing defect of the inner half of the upper end of the tibia is more distinct.

of the tibia is more distinct, and we can see that it overlaps the epiphyseal line. It is in marked contrast to the normal architecture of the outer head of the tibia.

This x-ray was studied by the previous observers, who were still of the opinion that it could more easily be explained by a low grade osteomyelitis or tuberculosis. In the lateral views of the normal and diseased side, taken November 20, there is no evidence of periosteal bone formation between the tibia and fibula, but the cloudy defect of the upper end of the tibia is distinct on the diseased side.

Third x-rays, November 28, 1922: (Figs. 5 and 6). These pictures were taken by Dr. Kahn in my office in Baltimore. The soft-part tumor seems a little larger. The lighter areas in the cloudy defect in the upper end of the tibia are getting a little larger. (For lateral views see Figures 7 and 8).



Figs. 5 and 6—(Pathol. No. 31698)—(B. T. 9)—Fig. 5, normal right side. Fig. 6, diseased left side. These x-rays were taken by Dr. Kahn, November 28, 1922, eight days after Figures 3 and 4. The periosteal soft-part tumor over the inner head of the tibia is distinctly larger. The periosteal bone formation is about the same. The cloudy shadow of the sclerosing sarcoma is perhaps a little larger. The uninvolved bone to the outer side is narrower in width.

Figs. 7 and 8—(Pathol. No. 31698)—(B. T. 9)—Fig. 7, normal right side. Fig. 8, diseased left side. Lateral views taken by Dr. Kahn November 28 1922. There is definite new periosteal bone formation from the posterior side of the upper end of the tibia, and the cloudy shadow of the sclerosing sarcoma in the upper end of the tibia is distinct.

This periosteal bone formation in Figure 8 is not present in the lateral views taken November 1 and November 20.

Examination of Patient: Young girl, aged 16, looks in perfect health. There is some visible swelling in the region of the knee joint which could be easily explained by the plaster case which hase now been removed two days. Also the restriction of flexion in the knee-joint can be explained by the fixation. As one palpates the shaft of the tibia over which there is no muscle and moves upwards, one meets a little below the level of the tubercle a soft swelling about five to eight millimeters in height covering the bone and preventing palpation of the bone. This is tender. The moment the finger feels this swelling the patient says that it hurts. The swelling continues a little above the epiphyseal line, but not to the plane of the knee joint. It cannot be felt where the tibia is covered with muscle.

Other Examinations: To repeat, these were negative both in Boston and in Baltimore. There had been and was no rise of temperature; there was no leukocytosis and no increase in the polymorphonuclear leukocytes. The x-ray of the chest gave no evidence of a possible tuberculous lesion, and no foci of infection could be made out in nose, throat or teeth.

Previous History: When the child was 15 months of age, there had been an attack of fever, followed by conjunctivitis and enlarged cervical glands. At that time the Von Pirquet test was positive, and the child was being cared for by a nurse who had tuberculous laryngitis. The child's adenoids were removed at this time, and then for several years there were recurrent attacks of conjunctivitis and bronchial asthma. With this exception, the child apparently had had no illness and was in perfect health. The father stated that the child was very fond of athletics, played tennis a great deal, and for this reason a positive contusion could not be excluded.

Discussion of the case from the clinical history, examination and x-rays: From my previous experience the picture suggested a periosteal sarcoma of the sclerosing type, but the possibility of tuberculosis would have to be considered, and this was based not on the previous history, but on the wedge-shaped area in the involved bone. In the August Journal[1] I have discussed and pictured the x-rays of the non-suppurative sclerosing osteomyelitis as described by Garre. All of my cases were adults, and in none did the clinical picture or x-ray resemble this case. I have read carefully the article of

Klemm,[5] who describes this lesion chiefly in children.

I am giving here a copy of what I dictated when Dr. Greenough and I studied the x-ray plates together and he told me about the clinical history. Neither of us at that time had examined the patient.

Remarks, November 26, 1922: "If this is sarcoma, I doubt if it could be removed by a local operation which would leave a leg with good function, because in sarcoma of this type the infiltration of the sarcoma cells is often far beyond the x-ray defect." (This was based on a microscopic study of previous similar cases). "Resection of the upper end of the tibia with bone transplantation does not give as good a functional result as amputation and an artificial limb. If amputation is to be performed it must be above the condyles of the femur.

"Amputation offers four per cent chances of a cure.[6] One of the cured cases reported in March, 1920, was a girl, aged 11 years, with a similar sclerosing sarcoma of the upper end of the tibia, in which the amputation was performed two weeks after a piece was excised for diagnosis. This case (Pathol. No. 14143) has been registered and accepted in the Codman registry. It is now nine years since the amputation. On further study I think we may offer this child a larger per cent of cure; this four per cent reported in 1920 includes both the upper and lower extremity, and as we have cured no sarcoma of the upper extremity, the chance of a cure in the lower extremity is almost eight per cent; and if we consider only sarcoma of the upper end of the tibia of the sclerosing type, we have cured one out of three, or thirty-three per cent, and another has been reported and accepted in the Codman registry.

"The wedge-shaped area suggests tuberculosis, although tuberculosis of bone without joint involvement is rare.

"The diagnosis rests between a periosteal sarcoma of the sclerosing type rapidly involving the shaft of the tibia, and tuberculosis. I have never seen chronic osteomyelitis produce a picture of this kind.

"My advice would be to employ gas anesthesia and the Esmarch rubber bandage and make a skin incision, and from then on to use the electric cautery. I would advise removing a piece of the overlying soft parts with a wedge-shaped piece of bone, burning thoroughly with the cautery and swabbing with pure carbolic followed by alcohol, then packing for ten minutes with zinc chloride fifty per cent solution.

"If the gross and the frozen section suggest sarcoma, introduce radium needles; if not, pack the wound with gauze and let it heal by granulation. If the section suggests sarcoma, submit the section to a number of pathologists and if they all agree, the decision must be made between amputation on the one hand, and radium or x-ray treatment on the other. Another evidence in favor of sarcoma is the rapid involvement of the shaft within twenty-one days.

"My personal advice would be to make immediate exploration as suggested, and if all pathologists agree as to sarcoma from the frozen section, to amputate immediately. If there is any doubt as to malignancy leave radium needles in the wound, to be followed quickly by x-ray treatment, while waiting for the further study of the section.

"There is one other possibility to be considered: If it is decided that the lesion is sarcoma, to continue removing bone up to a point that further removal would interfere with the function of the limb, and studying this bone removed, to see the effect of treatment."

Since this was written I have gone over my cases of tuberculosis of bone without joint involvement, and in not a single case is the x-ray similar to the one in this case. The x-rays show a large defect, with an intact or perforated bone shell—a picture like central bone tumor, benign or malignant. Further intensive and repeated study since this was written leads to the conclusion that only the sclerosing type of sarcoma produces an x-ray picture of the type in this case.

I have quoted this in full, because in my consultation with Dr. Greenough we both agreed that the most important thing was first to ascertain the exact nature of the pathological process, because both of us were of the opinion that if sarcoma was diagnosed, amputation should be the method of choice.

Operation: St. Agnes Hospital, November 29th, 1922. Fortunately, the father is a member of the medical profession and an unusually well trained and experienced pathologist, and he agreed with Dr. Greenough and myself that amputation should be the method of choice if at the exploratory operation we could determine that the lesion was sarcoma.

The child was anesthetized with nitrous oxide and oxygen gas throughout. A wide Martin rubber band was placed on the thigh high enough to allow an amputation above the condyles of the femur. An incision was made with the knife through the skin over the inner medial head of the upper end of the tibia. The exposed tissue was normal. The fascia was divided with the electric cautery. There was then exposed a definite growth of about eight millimeters in thickness between the periosteum and the shaft. There was no evidence of infiltration through the periosteum. When this tissue was cut and inspected it resembled sarcoma of the fibrosarcoma type, that is, with

Fig. 9—(Pathol. No. 31698)—(B. T. 9)—Photograph of a longitudinal section through the upper end of the tibia. The dark defect in the bone is the area removed and cauterized. The white dense areas around this operative cavity are produced by the sclerosing sarcoma infiltrating and replacing the cancellous bone. The line of demarkation betwsen diseased and normal tissue is dictinct.

much intercellular connective tissue. There was no evidence of tubercular granulation tissue, nor of pus, or pyogenic granulation tissue. An immediate frozen section was made by Mr. Edward Walker, the technician of the Surgical Pathological Laboratory of the Johns Hopkins Hospital. I will discuss the method of fixation and staining later.

As the periosteal growth was stripped back with the cautery, the surface of the bone was rough with spicules of periosteal bone and minute cortical defects. The bone was too hard to remove with the cautery. For this reason a piece was chiseled, and it had the gross appearance of sclerosing sarcoma. In this type of sarcoma there remains cancellous bone, but between the little spicules of bone there is firm, white tissue. In tuberculosis we always see gray granulation tissue, and the bone about the area is softer, osteoporosis. In osteomyelitis we see granulation tissue, an entirely different picture from sclerosing sarcoma. From this bone area I was able to pick out some minute pieces of soft-part tumor without bone for frozen sections.

Gross Diagnosis: As I have described the picture which, of course, does not compare with seeing it, there could be but one conclusion—sclerosing sarcoma.

The gross appearance is shown in Figure 9 and the x-ray of a longitudinal section in Figure 10.

Frozen Sections: Figures 11, 12 and 13 are from frozen sections made at the time of the operation. The tissue was hardened in formalin and cut and stained with hematoxylin and eosin, and results were sufficiently good to make a positive diagnosis of sarcoma, but the frozen section which showed the morphology of the sarcoma cell best was made without hardening in formalin and stained with Terry's polychrome methylene blue. This technique is employed by MacCarthy and Broders in the Mayo Clinic. When I looked at these sections, I found that both the spindle and round cells were much more distinct than in the section shown in Figures 11, 12 and 13, and the nuclei were especially more distinct, and in a number of the larger spindle and round cells I could see two or three nuclei, a finding which distinguished the cells from those in inflammation. You will observe in the photomicrographs illustrated here that cells usually present in an inflammatory reaction, the lymphoid cells and the young capillaries, are absent, and the polymorphous leukocytes of osteomyelitis are absent.

The father of this patient to whom I have already referred as an experienced pathologist, agreed with the diagnosis of sarcoma and consented to the amputation, which was immediately performed.

Amputation: It was circular with skin flap only. The bone was divided above the condyle and the muscles at the level of the bone.

The vessels were carefully ligated with chromic catgut and the Esmarch bandage removed. The muscles were sutured together with chromic catgut, but not over the bone. The bone was sawed through without pushing up a periosteal flap. This method of amputation is the one that has been established as best by the recent experience of army surgeons.

Sclerosing Osteogenic Sarcoma

My studies agree with Ewing[3] that this is a distinct type, and I propose in a second communication to make a careful study with illustrations of this type of sarcoma. It seems best in this article to limit the discussion to this one case which brings out the method of diagnosis and treatment.

Similar descriptions of other types of sarcoma of bone will appear from time to time with illustrative cases as the investigation proceeds. My studies so far seem to be convincing that the sclerosing type of sarcoma of bone should be recognized in the x-ray. Its treatment will depend upon the point of view of the one responsible, the choice being between x-ray or radium radiation, and exploration, with further diagnosis by gross and frozen section, followed by resection or amputation.

The Importance of a Technician for Frozen Sections in the Operating Room

Recent experience, especially in early lesions of bone and in very young and small tumors of the breast, have convinced me that the ultimate diagnosis in an increasing number of cases must rest largely upon the microscopic study of the immediate frozen section. The accuracy of the interpretation of this section in an increasing number of cases is dependent upon the technique and the expertness of the one who makes the section; without this the possibilities of an accurate and rapid interpretation are greatly reduced.

I am very anxious to bring this important conclusion to the surgeons throughout this country, with the hope that it will influence them to start at once in the proper training of a technician to make these frozen sections in the operating room.

The Polychrome Methylene Blue Method of Terry[7] and MacCarthy

With the aid of Mr. Edward Walker, the technician of the Surgical Pathological Laboratory of the Johns Hopkins Hospital, I have given this method of Terry and MacCarthy a continuous trial since Dr. Terry spent a summer in my laboratory, some three years ago, and at the present moment I am strongly inclined to look upon these sec-

Fig. 10—(Pathol. No. 31698)—(B. T. 9)—An x-ray of the gross specimen shown in Figure 9. The cavity formation in the bone is the operative defect. The cloudy areas infiltrating the cancellous bone are sclerosing sarcoma tissue. On the inner side the disease is obliterating the epiphyseal line. The periosteal tumor without bone formation shows slightly over the defect in the cortical bone. New periosteal bone formation is not seen.

tions made by freezing unhardened tissue and staining it with the polychrome methylene solution as a very important addition to the quick frozen section made after hardening in formalin and staining with eosin and hematoxylin, and I would advise my colleagues to try it.

Unfortunately for the development of this frozen section technique the number of cases in which it is essential for diagnosis is relatively small in the majority of operating rooms in this country. To develop it, it should be practiced daily by the technician and those who look through the microscope. It should become the routine procedure in every operating room, because then, when a case comes for a real test, you will have a large experience in interpretation.

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Fig. 11—(Pathol. No. 31698)—(B. T. 9)—High power of periosteal growth without bone formation, stained with eosin and hematoxylin. This shows the spindle and round sarcoma cells imbedded in the eosin-staining fibrous stroma.

Fig. 12—(Pathol. No. 31698)—(B. T. 9)—A second frozen section from the periosteal tumor; same staining as Figure 11. The sarcoma cells are more uniformly distributed in the eosin-staining fibrous matrix.

Fig 13—(Pathol. No. 31698)—(B. T. 9)—A piece picked out of the tumor area in the cancellous bone (low power); same staining as in Figures 11 and 12. This shows that the cancellous bone is largely destroyed. There remain here and there spicules of bone. This bone is replaced chiefly by a dense eosin-staining fibrous tissue in which are imbedded the sarcoma cells shown under high power in Figures 11 and 12.

X-Rays and X-Ray Apparatus: An Elementary Course*

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THE FOLLOWING is the first of a series of articles written primarily for those whose knowledge of physics is limited. The aim of the writer has been to present, in as simple a manner as possible, certain fundamental physical principles without a knowledge of which the intelligent use of either x-rays or x-ray apparatus is impossible. The articles are written, not for the expert roentgenologist, but rather for the novice in the field of radiology. It is hoped, too, that they will prove of use in helping any one interested to read intelligently the rapidly increasing literature on this subject.

I.

THE INTERRUPTERLESS TRANSFORMER

To operate any type of x-ray bulb, a high voltage must be applied to the terminals of the bulb. By "high" is meant a voltage which is many times greater than any of those ordinarily available. To be more definite, a dry cell of the type familiar to everybody, has a voltage between its terminals of about 1.4 volt, while a small storage battery has a value of about two volts. Between the lead wires which deliver electric power to the average householder, the common voltage is 110, although by special arrangement a supply of 220 volts may be obtained. But before useful x-rays may be obtained from a bulb, voltages of the order of 20,000 or very much higher must be used. There are on the market machines making available 300,000 volts. How are these high values obtained?

At least three different types of machines have been used for this purpose, (1) the "electrostatic" electric machine, such as the Wimshurst; (2) the transformer; (3) the induction coil. The first type is of scarcely more than historical interest in these days of powerful x-ray outfits, and need not be considered in this article. It is highly desirable, however, that every user of an x-ray bulb be familiar with the second and third types, and each of these will be discussed in detail. Both are based on two important fundamental principles, first that of electro-magnetism; second, that of electro-magnetic induction. Before proceeding to an explanation of these, a few simple electrical terms will be defined.

The volt is a unit of electrical pressure, or speaking more scientifically, of difference of potential. Voltage or difference of potential, is always necessary before any current can flow, just as difference of pressure is necessary, before water will flow along a pipe. Voltage, however, is not current any more than water pressure is the volume of water flowing per second.

Voltages available may be one of two types (1) D.C. (direct current) where the polarity never reverses, (2) A.C. (alternating current) where the direction of flow is continually reversing. A dry cell has a voltage of 1.4 (D.C.) while the ordinary hourse is generally supplied with 110 (A.C.)

The *ampere* is the unit of current and has to do with the quantity of electricity flowing past any point in a cirsuit per second. To make the matter more concrete, when 110 volts are applied to a 20 watt tungsten lamp, a current of about one-fifth of an ampere is flowing through the lamp; when a 600 watt electric iron is joined to the 110 volt lighting circuit, a current of from five to six amperes is flowing through the iron. The voltage causes the flow, but the current (again the quantity of electricity passing a point per second) depends both on the voltage and on the opposition to the flow between the points to which the voltage is applied—that is, it depends also on the resistance. To use a water analogy once more, water pressure causes a flow but the quantity of water flowing per second through a pipe depends both on the water pressure and on the size of the pipe.

A *rheostat* is a simple device for altering the amount of wire in an electric circuit, that is, of varying the resistance, and therefore, of regulating the magnitude of the current (within limits).

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In Figure 1, if the movable arm AB s in position I, the current flows hrough coils 1 and 2; if the arm is noved to position II, the current must low through coils 1, 2, 3, 4, that is, ıgainst a greater amount of resistance. Hence the current in the second case vould be smaller.

A *milliampere* is just one-thousandth of an ampere. As will be seen later, he current flowing through the primary of an x-ray transformer is measured in ımperes, possibly as high as 30, while he current through the x-ray bulb itself s such a small fraction of an ampere that its magnitude is invariably given in milliamperes (ma.).

The Principle of Electro-Magnetism

Most readers are familiar with the fact that when a small bar magnet is placed beneath a sheet of paper, and iron filing are sprinkled on it, the filings arrange themselves along regular lines somewhat as represented in Figure 2. This simple experiment indicates that in the whole region around the magnet there is what is called a magnetic field of force. To visualize this field we generally say that it is traversed by magnetic lines of forces, the closeness of the lines of force at any particular place being a measure of the strength of the magnetic field at that place. These lines of force are closed curves leaving the N pole of a magnet, entering the S pole and we say there is a magnetic flux through the magnet. Indeed, whenever magnetic lines are passing through any region, we speak of a magnetic flux through that region.

Suppose, now, that the wire AB (Fig. 3) is carrying a current of several amperes, and we sprinkle iron filings on a sheet of paper through which

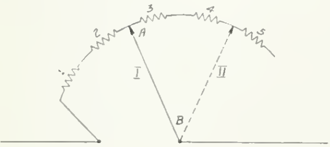


Fig 1

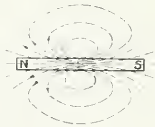


Fig 2

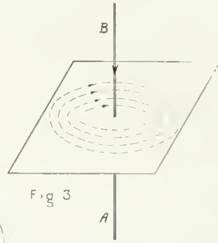
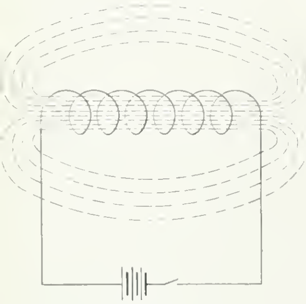


Fig 3


BATTERY
Fig 4

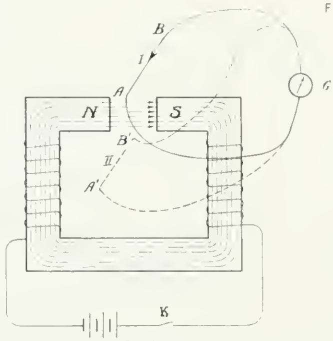
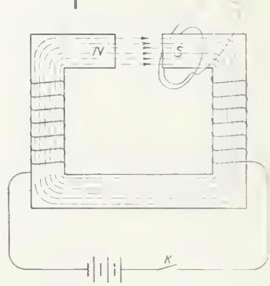


Fig 5



Battery
Fig 6

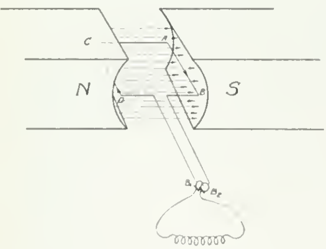


Fig 7

Fig 8

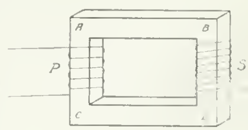


Fig 9

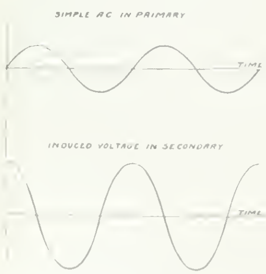


Fig 10

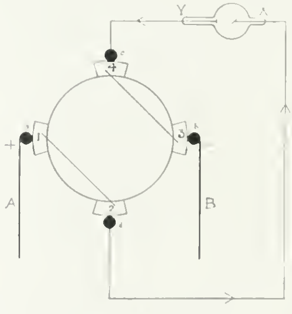


Fig 11

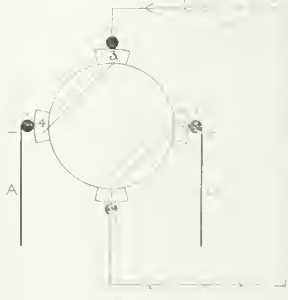


Fig 12

the wire passes. We find that, so long as the current is flowing, the filings are arranged in circular lines with the wire as centre. *A magnetic field, therefore, surrounds a wire carrying a current.* This is the fundamental principle of electro-magnetism. We can have magnetic fields subject to the control of an electric current. If a wire carrying a current is wound into what is called a solenoid (Fig. 4) it can easily be shown that one end of the solenoid acts as the north, the other end as the south pole of a bar magnet with magnetic lines of force somewhat as represented in the figure. Obviously these lines are linked with the electric circuit, and at once disappear when the electric circuit is broken. If the air inside the coil be replaced by soft iron, the soft iron becomes strongly magnetized under the influence of the magnetic field due to the current, and the number of lines of force may be increased many times. We have, in fact, an electro-magnet. Break the circuit, the lines of force disappear; make the circuit, the lines of force are introduced. Electro-magnets are frequently of the shape illustrated in Figures 5 and 6 below.

The Principle of Electro-Magnetic Induction

This may best be explained by reference to one or two simple experiments. Suppose we are provided with an electro-magnet of the type illustrated in Figure 5 (where the lines of force are again represented by dotted lines) Imagine also a simple electric circuit containing a wire AB which may be readily moved, a current-measuring instrument G, but no cell or battery or other source of voltage. Suppose next the switch K controlling the electro-magnet circuit is closed and in this experiment left so. If now the wire AB is moved from position I across the lines of force to position II (A′ B′) a momentary current in the opposite direction is recorded. In general, it will be found that as long as the wire is cutting the lines of force, there is a current whose direction depends on the direction of motion of the wire. Such a current is called an induced current, the voltage causing it, an induced E.M.F. (electro-motive force). *Whenever, therefore, a portion of any circuit is moving with reference to magnetic lines of force, there is an induced E.M.F. (voltage) in that portion of the circuit, and if that circuit is closed a current results.* This is the very important principle of electro-magnetic induction.

The principle may be stated in another and possibly more useful way. This will be evident from another look at Figure 5. When the movable wire is in position A′ B′ there are no lines of force linked with this circuit, but when it is in position A′ B′ all the lines of the electro-magnet are linked or interlocked with it. We frequently say, therefore, that an induced voltage results in an electric circuit whenever there is any change in the number of lines of force linked or interlocked with it. To emphasize this, we shall perform another experiment. Imagine the movable wire in position A′ B′. If, now, the electro-magnet circuit (which we shall call the primary) is broken, a momentary induced current results in the movable wire circuit, which we shall call the secondary. Again, when the primary circuit is made, a momentary current in the opposite direction results in the secondary. In this experiment, the secondary circuit is not moved, but the magnetic lines of force either disappear or reappear, and there is relative motion of magnetic lines and a portion of a circuit, and so an induced current results. Putting it in the other way, at "break" of the primary, there is a decrease in the number of lines linked with the secondary; at "make" an increase—in both, a change and an induced voltage results.

Magnitude of Induced Voltage

This involves a consideration of two other points. (1) If the wire AB (Fig. 5) be moved from position I to position II at two different rates, for example one ten times faster than the other, it will be found that the induced current is just ten times as great, although it will, of course, last for a correspondingly shorter time. In other words, the magnitude of an induced voltage depends on the rate at which the change in the number of linkings takes place. The faster the change, or the more quickly lines are cut, the higher the induced voltage.

(1) If the secondary circuit be altered, as represented in Figure 6, so that the magnetic lines of force link the circuit twice, it will be found that on "break". of the primary circuit the induced voltage is twice that obtained previously. If the secondary circuit links the lines ten times, then the induced voltage would be ten times as great, and so on.

To sum up: The magnitude of an induced voltage in any circuit depends (1) on the rate at which a change in the number of magnetic lines linking a circuit takes place, and (2) the number of times the lines are linked with the circuit. It follows, therefore, that if a circuit is linked a large number of times with magnetic lines, and these disappear (or are introduced) very quickly, that extremely high voltage may be induced.

Meaning of A. C.—Sinusoidal

Suppose a single loop of wire, ABCD, Figure 7, is rotated in the region between two powerful magnetic poles N and S. As the wire AB goes down it cuts across lines of force and in it we have an induced voltage in the direction of the arrow. At the same time the portion of the loop CD goes up, thus cutting the same lines in the opposite direction, and an induced voltage in the opposite direction (Sec. 4) results. If, now, the ends of the loop are connected to two slip rings, upon which rest brushes B_1 and B_2 connected by some external conducting circuit, an induced current may flow. Evidently, all the time AB is going down and CD up (that is, for half a revolution) a circuit will flow through this circuit in the direction indicated by the arrows. When AB reaches its lowest position, however, it begins to move up, and then the direction of the induced voltage will change. At the same time, the wire CD will have reversed its direction (up to down) and in it, too, the induced voltage reverses. It follows, therefore, that during the second half revolution the current throughout the circuit will flow in the opposite direction to that during the first, and that as rotation continues, the current reverses in direction every half revolution.

Not only, however, is there a reversal of current (or, if you like, of polarity between the brush B_1 and B_2) but the strength of the current is continually changing. This will be evident if it is realized that when the wire AB is passing through its highest position and the wire CD through its lowest, each wire is moving parallel to the magnetic lines and hence for a short interval of time there is no cutting and, therefore, no induced voltage and no current. As AB goes down (and CD up) the lines are cut more and more quickly, until after one-quarter of a revolution both AB and CD are moving directly at right angles to the lines. At this instant, therefore, the magnetic lines are cut at the fastest rate and the biggest induced voltage results. For the next quarter of a revolution, the lines are cut less and less quickly until AB reaches the bottom (CD the top) and once more, for a brief moment, each wire is moving parallel to the lines, and the voltage has dropped to zero again. Evidently, then, during one complete revolution, the current in the circuit will gradually rise in one direction to a maximum value, drop until it is zero, from which it gradually climbs to a maximum, again falling to zero.

If the loop is rotated at steady speed, and in a uniform magnetic field, the manner in which the current changes with time is represented graphically in Figure 8.

A current of this type is an alternating one (A.C.) as well as sinusoidal. Obviously, a sinusoidal current is characterized by (1) changing polarity and (2) gradual, "smooth" changes in intensity. In passing, it may be noted that by using a mechanical means such as a revolving drum, to put in and take out resistance gradually from a circuit, sinusoidal effects without changing the polarity may be obtained.

It is well to note that while a sinusoidal current is always A.C., it is possible to have alternating currents which are not sinusoidal.

Two or three important terms should be noted.

A cycle refers to the complete change from zero to a maximum in one direction, down through zero to a maximum in the other direction and back again to zero. In Figure 8, OA represents a cycle.

The *frequency* of A.C. is the number of cycles per second. Most householders on the American continent are supplied with A.C. at 110 volts, with a frequency of 60 or 30 cycles per second.

Neither this voltage nor this frequency could be generated with a simple machine of the type illustrated. In the practical A.C. generators or dynamos found in power houses, the desired frequency and voltage are obtained by using several sets of magnet poles, alternately north and south, and many loops of wire. The fundamental principles utilized, however, are the same as those we have been discussing and the current supplied by such generators generally approximats fairly closely the sinusoidal.

The High Tension Transformer

We are now in a position to explain the principle of the high tension transformer.

In Figure 9, ABCD represents a series of sheets of soft iron put together to form a "core" of iron of the shape illustrated. A coil of wire P, the primary, which is connected with a source of 110 volts (A.C.) is wrapped about one arm of the iron core. When this primary circuit is closed, the alternating current will magnetize the iron core, first with lines running in one direction, then in the opposite. As the iron core is of the shape illustrated, the lines, whatever their direction, run somewhat as represented by the dotted lines. Suppose, now, a second coil S, the secondary, is wrapped about another portion of the iron core. Evidently the magnetic lines, when present, are linked with each turn of this coil. Moreover, the number of lines linked with the coil is continually changing. As the number of lines is rising to a maximum (increasing) in one direction, we shall have an induced voltage in coil P in one direction; as the number decreases, there will be an induced voltage in the opposite direction. Without going into further detail, corresponding to current changes in the primary, there will be induced voltages in the secondary which vary in the manner represented in Figure 10.

There is, therefore, an induced voltage in the secondary which is alternating (A.C.) and of the same frequency as that of the primary. Concerning the magnitude of this induced voltage, it should be evident (Sec. 5) that by using a large number of turns in the secondary, extremely high values may be obtained. As a matter of fact, the voltage is "stepped-up" roughly in the ratio of the number of turns of the secondary to the number of turns of the primary. High tension transformers are now on the market, which it is the claim of the makers, will deliver a voltage as high as 300,000.

Necessity of Rectification

For the satisfactory use of any x-ray bulb the current flowing through it must always be uni-directional. It may be intermittent but unless its direction is always the same, and correct, the results on the tube may be disastrous. As a rule, therefore (one or two exceptions will be noted later), the high tension transformer because it delivers alternating current, is not sufficient for a complete x-ray high voltage outfit. Some device must be added so that the current through the tube is always in the same direction. Either one-half of the cycle must be suppressed altogether, or by means of what is called a rectifier, the alternating voltage between the high tension terminals of the transformer must be applied to the tube with unchanging polarity. In the so-called interrupterless transformer such a device is added. The principle is simple and should be clear from a consideration of Figures 11 and 12.

In these figures A and B represent heavy lead wires coming directly from the high voltage side of a transformer. Each circle represents a disc, which may be rapidly rotated and is made of some good insulating material. Attached to the disc are four projecting pieces of metal (1, 2, 3, 4), 1 and 2 being connected by a piece of wire, similarly 3 and 4. As the disc revolves, these pieces touch fixed metal brushes (*a*, *b*, *c*, *d*), *a* and *b* being attached to the lead wires A and B, while by means of *c* and *d* connection may be made with a circuit containing an x-ray bulb. Suppose now, that as the disc rotates, it reaches the position indicated in Figure 11, at the moment the voltage between A and B is a maximum (the "peak" of the sinusoidal curve), A being +, B —. At that instant, then, a current will flow from A to *a* to 1 to 2 to *d*, through the bulb in direction X to Y, back to c to 4 to 3 to *b* to other lead wire B. Suppose further that during the time of one-half a cycle, the disc revolves to position shown in Figure 12. In that case, since the voltage between A and B is now once more a maximum, but with A — and B +, a simple inspection of the diagram in Figure 12 will show that the current flows from B to *b* to 2 to 1, through the bulb in the same direction as before to 3 to 4 to *a* to A. In other words, if the disc can be rotated at this very exact speed, then the current through the bulb will always be uni-directional. In the transformer secondary coil, of course, it is alternating just as before. This exact co-relation between the speed of the rectifying disc and the frequency of the alternating current is obtained by means of what is called a synchronous motor. Before an explanation of the principle of the synchronous motor is given it is well to note that, although the current through the tube with the above arrangement is uni-directional, it is also intermittent. A glance at Figure 13 should make it clear that when the disc is in the position indicated in that diagram, there is no current through the tube because neither *a* nor *b* touches a metal projection. Evidently the length of time the current is flowing will depend on the size of the projecting pieces, that is, on the time they are in contact with the lead wires A and B. This time interval therefore may be and probably is different in different machines. If it is very short, only the "peaks" of the voltage values will be utilized as represented graphically by the short heavy line in Figure 14 (a). If the time interval is a little longer, a greater portion of the whole range of voltage values will be utilized, the short heavy lines extending to the dotted parts. It is well to note further that, in order to utilize the peak voltage, the disc must be in proper alignment, that is, when it is in the position represented by Figure 11, the voltage across A and B must be at its maximum value. Sometimes the disc slips on its rotating axis and gets out of alignment. To readjust it the services of an electrical engineer may be necessary.

In actual practice it is found that the high tension voltage curve departs to some extent from the sinusoidal form, and indeed varies somewhat with the conditions under which the tube is being used. The effect of this on x-ray measurements will be seen later. In the meantime, while Figure 14 is more or less ideal, that in no way effects the general truth of what has been said.

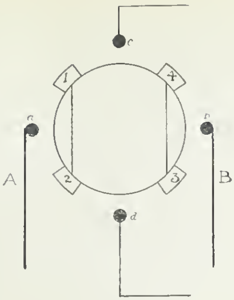


Fig 13

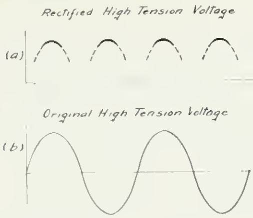


Fig 14

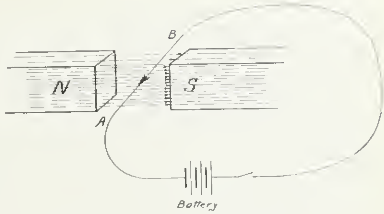


Fig 15

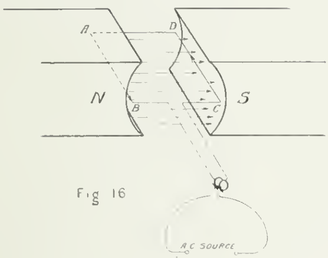


Fig 16

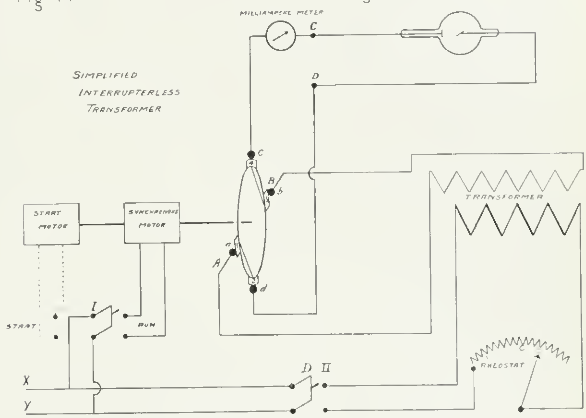


Fig 17

Fig 18

Fig 19

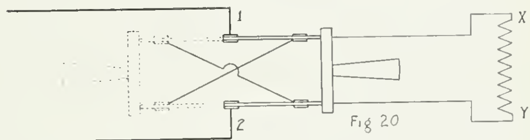


Fig 20

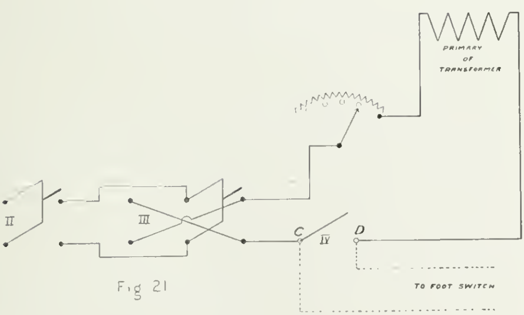


Fig 21

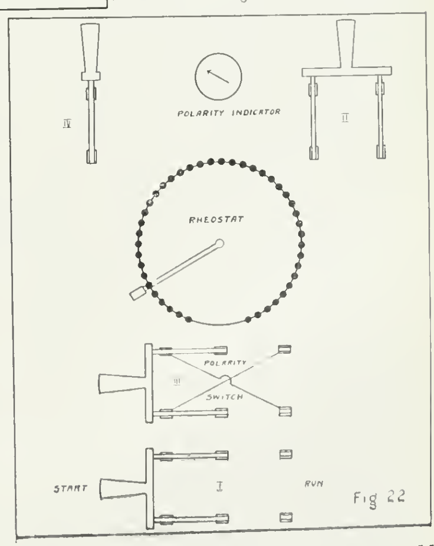


Fig 22

The Synchronous Motor

Neither radiographers nor therapists nor even physicists can be expected to be familiar with the detailed construction of synchronous or indeed other types of motors. That is the work of the electrical engineer. For any one, however, to operate an x-ray outfit intelligently it is necessary to understand the basic principles utilized in the apparatus one is handling. A simple explanation, therefore, of one type of synchronous motor will be given. As is the case with all motors, there is one fundamental underlying principle which we shall call the motor principle.

In Figure 15, AB represents a wire which is part of a circuit including a battery or some other source of voltage. If this wire lies in a magnetic field, as illustrated, and it is free to move, it will be found that on completing the circuit of which it is a part, the wire is pushed either up or down. With the current in the direction of the arrow, motion is up; with current in the opposite direction, motion is down. This simple experiment which may readily be performed, illustrates the motor principle. *Whenever a wire carrying a current lies in a magnetic field, because of the interaction between this magnetic field and that due to the current* (Sec. 3) *the wire is acted on by a force.* If the wire lies at right angles to the magnetic field, as in Figure 15, it is pushed at right angles both to the lines of force and to itself; one way, for current in one sense, the opposite way for current in opposite direction. Any one familiar with the electrocardiograph apparatus will recognize the same principle utilized in the Einthoven galvanometer.

Now, let us apply this principle to a coil ABCD, free to rotate in the region between two magnet poles, and supplied with alternating current. Suppose the coil is at rest in the position shown, when the current is in the direction of the arrows. Then CD will experience a push down, AB up, and the coil will start to rotate. If, however, the current is alternating and the coil has any inertia to speak of, before it has had a chance to rotate an appreciable amount, the current will reverse, and the forces on both AB and CD will reverse also. As a consequence there will be no actual rotation. Suppose, however, that by some external means the coil is previously rotated at such a speed that it just reaches the vertical position at the moment the alternating current is passing through the zero value. This means that when the current begins to flow in the reverse sense a push on CD in the upward (reverse) sense will simply help to keep the coil rotating in the same way. Again, after another half revolution, CD will be at its highest position and ready to go down when the reversal takes place. There is, therefore, a very special speed such that a coil will keep rotating in synchronism with the changes in an alternating current. Once it is simply brought up to this speed by some external means it keeps running at exactly the same rate, because, once more, the reversals of current take place at just the right instant to cause rotation always in the same sense. In an interrupterless transformer outfit, therefore, the rectifying disc is rotated at the required exact speed by means of a synchronous motor. It is neither necessary nor advisable to discuss the practical details of its construction. We have sought only to explain the basic principle of a type in common use, and we have done so partly to show why in so many x-ray machines some device is necessary for bringing the synchronous motor up to speed. In some machines a starting motor of another type is added solely for this purpose. In others a starting switch closes a branch circuit in the synchronous motor and has the effect of making it temporarily another type of motor until it comes up to speed. In others there is a single synchronous motor built on a different principle, which comes up to speed without any external aid.

A Simplified Interrupterless Transformer

We are now in a position to consider the operation of a simplified but complete x-ray transformer outfit. In Figure 17, X and Y represent main leads, 110 or 220 A.C. The mains branch into two circuits, one supplying current to the synchronous motor, and controlled by Switch I; the other supplying current to the primary of the high tension transformer, controlled by Switch II. In addition there is the high tension circuit, including the secondary of the transformer, the x-ray tube and a milliamperemeter, with the rectifying disc placed so as to send a unidirectional current through the tube. The diagram should make clear without further explanation the connections of the tube circuit. It may be stated, however, that the parts of the rectifying arrangement are labelled as in Figures 11 and 12, and that C and D correspond to the high tension terminals usually found on the top of the x-ray cabinet which "houses" the transformer, the motor or motors, and the disc.

To operate, then, with such an arrangement, the tube is first placed in position and connected by means of extensible wires to the high tension terminals C and D. This circuit is then closed and is as illustrated in the figure. Next the synchronous motor is brought up to speed. In the arrangement we are considering, this is done by throwing Switch I to the side marked "start," thus utilizing the starting motor, until the requisite speed is attained. Switch I is then thrown to side marked "run" and left there. The rectifying disc is now running at the necessary exact speed and may be left so for some length of time. As noted above, in other types this procedure would be slightly different. In the case of some machines it is simply necessary to close a switch corresponding to Switch I above.

Finally to use the x-ray tube, Switch II, the so-called x-ray switch, is closed, thus supplying the primary of the transformer with current, and so causing an induced high voltage in the secondary, which in its turn causes a current to flow through the bulb and milliamperemeter in the closed secondary circuit. The strength of this current may be altered by putting in or taking out resistance by means of the rheostat.

Direction of Current Through the Tube

Not only must the current through an x-ray tube be uni-directional, but it must also be in the right direction. Now, if one went through the series of operations which have just been outlined, it might be found on closing Switch II that the current was going through the tube in the wrong way. Just how one would know that, will be explained later. In fact, if one began one hundred times, at the beginning, with all the switches open, it would be found that on closing the x-ray Switch II, on the average, fifty times the x-ray current would be in right direction, fifty times wrong. In other words, with the above arrangement and procedure, it is just an even chance, whether current is right or wrong. A glance at Figure 11 will explain the reason for this. In this figure it has been assumed that when the disc is in the position indicated, A is positive and B negative. Now, when it is brought up to speed, there is just as good a chance of A being negative and B positive, as vice versa. If that were the case in Figure 11, then the current through the tube would always flow from Y to X, not X to Y. With the above simplified arrangement, therefore, when the x-ray switch is closed, one would never know whether the current through the tube would be in the right or the wrong direction. If it were wrong, it would then be necessary to open the motor switch and close it again until the right direction was obtained. Now, such a procedure is decidedly bad for the tube. How, then, can it be avoided?

The Polarity Indicator

There are at least two ways, one inconvenient and seldom used; the other in constant use in connection with al-

most every interrupterless transformer on the market.

The first consists in having a "point-plane" spark gap connected to the high tension terminals, and by closing Switch II before the bulb is placed in position, allowing a spark to "jump" the gap. If the spark "jumps" as indicated in Figure 18, that is, from point to central portion of the disc, the point is positive; if the spark is as illustrated in Figure 19, from point to periphery of the disc, the point is negative. By this means the polarity of the high tension terminals on the cabinet is determined before the tube is placed in position. It should be noted, however, that every time the synchronous motor is stopped, the same procedure would have to be repeated before subsequent use of the tube.

A much more convenient method is found in the use of the polarity indicator, a small instrument found on the switch board of nearly every interrupterless transformer. The instrument is a direct current ammeter, with a pointer which moves to the left of a zero for current in one direction, to the right for current in opposite direction. It is placed in a branch circuit taken off the motor circuit and through it flows a current which has been rectified. When the synchronous motor has come up to speed, therefore, the pointer is deflected to one side or to the other, depending on which way the current has been rectified. Suppose, now, with any given outfit, it is noted once for all, when the polarity indicator needle moves to the right, which of the high tension terminals is positive. To do so the x-ray switch would have to be closed. Then subsequently whenever the polarity indicator points in the same direction, the same terminal would be positive, because each circuit is supplied from the same A.C. source.

If the polarity indicator points in the opposite direction, what then? This simply means that the high tension terminals are of opposite polarity to that previously determined. Now, practically it is convenient always to work with a tube joined to the terminals in the same way. With the arrangement we are considering, therefore, it would be necessary to keep on opening and closing the motor switch until the polarity indicator finally pointed in the desired way. This, however, is not convenient. In actual practice, therefore, another switch, the pole changer or polarity switch, this time simply a reversing switch, is placed in the primary transformer circuit. By means of this the direction of the current through the primary may be reversed at any instant. Referring to Figure 20, if at a certain moment, terminal 1 is +, 2 —, and the switch is thrown as indicated, current will flow through XY in direction X to Y; if, however, switch had been in dotted position, current would have been through XY in direction Y to X. Accordingly, when the polarity indicator points the opposite way, without opening the motor switch, it is possible to change the polarity of the high tension terminals to that desired by simply reversing the polarity switch. In some machines, the original wiring is such that, when the polarity indicator moves to the right, the correct position of the polarity switch is also to the right, and vice versa.

In Figure 21 the primary transformer circuit is re-drawn to show the polarity switch (III.) as well as the way in which a foot switch is used.

The Foot Switch

Sometimes an operator may need the use of both hands and it is then convenient to be able to operate the tube by one's foot. When this is the case, the transformer primary line is broken at any convenient place (C and D, Figure 21) and two wires are lead from each side of the break to a switch (not shown), the two parts of which may be pressed together by means of the foot. If one does not wish to use the foot switch, it is necessary simply to close a small single knife switch (IV, Figure 21), connecting C and D. If it desired to use the foot switch, then first of all Switch IV must be left open, x-ray Switch II must be left closed, while finally the tube is operated by closing the transformer circuit with the foot switch.

In actual practice, for convenience, the various switches and controls are usually all placed on a common switchboard. Figure 22 is a diagram of the appearance such a switch board might have to correspond to the type of outfit we have been considering.

EDITORIAL

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Some Organization Problems and Possibilities*

THIS SOCIETY is our witness that we believe in organization of radiologists, and it may be conceded that the more comprehensive this organization is, the more effective it will be in its work. It may appear presumptuous for a comparatively unknown member of the society to attempt a discussion of its work and the direction in which its energies should be expended. My excuse is that some critical study has been given the subject and that a discussion of our problems appears timely.

Although not so worded in our constitution, our main objects can be covered by three headings:

I.—Scientific: To develop and advance the science of radiology.

II.—Organization: To perfect a closer association of the men and women practicing, or interested in radiology.

III.—Propaganda: To establish and maintain the practice of radiology as a specialized branch of medicine.

Scientific

The four objects of the Radiological Society, as stated by its constitution, look almost entirely toward the development and refinement of radiology as a science. Radiologic research, the providing of meetings, the publishing of our journal, the maintenance of library and museum, are all phases of one idea, concerned with self-centering of our energies. By virtue of this centripetal force, concentrating our influence within narrow bounds, naturally we have made great strides in one direction and may justly be proud of our scientific achievements of the past few years. Yet, self-improvement in the practice of radiology, for the individual, is the least important of the goals toward which this society, as a body, should direct its organized activity. Not because it is of minor importance that radiology as an art should advance, but because the other two objects hold greater opportunity for us, as a society, to attain our destiny. Radiologic science will advance through the initiative of the individual and we can have very little effect upon that advance; our business, in this connection, should be to gather up and present, at our meetings and through our journal, the achievements of the individuals. To devote a large portion of our resources to experimental or research work, for example, is an unwise distribution of energy. A small stream of water is lost when it empties into a large river, but it will bring wonderful returns if diverted and used to irrigate the desert.

Organization

Neither the Radiological Society nor the American Roentgen Ray Society states, as one of its objects, the development of a closer association of the men and women engaged in the practice of the specialty. Although this society has been very active in enlarging its membership and has made a remarkable showing in that respect, it must be assumed that this membership campaign is a secondary consideration, since it is not included among the primary objects of our society. In securing new members, through our state councillors, the principal object should be, not to add the prestige of well known names to our roll, nor to secure financial returns from a large membership, but to perfect a comprehensive and inclusive association of the radiologists of North America.

It is conservatively estimated that there are, in the United States and Canada, about 2,000 doctors interested in radiology as a medical specialty, which means that our society is less than fifty per cent efficient in organization. We can, with good reason, be proud of the work of our state councillors in bringing into our membership nearly fifty per cent of the radiologists of the country, within five years. It is a marvellous achievement, and such an efficient machine must not now be permitted to idle, but must be enlarged and prepared for the greater work ahead, which a view of some typical sections of the country will illustrate. In Massachusetts we have 19 members out of 75 radiologists; in New York 48 out of 154; in New Jersey 13 out of 35; in Pennsylvania 32 out of 122; in a group of southern states 31 out of 75; in Ohio 56 out of 87; in Indiana 29 out of 45; in Wisconsin 20 out of 31; in Texas 19 out of 56; in Oklahoma 9 out of 18; in California 34 out of 64. Although these figures include this year's applicants, they do not, by any means, adequately represent the field which needs to be organized, for radiology is developing more rapidly than ever before and men are entering the specialty by scores, and perhaps hundreds, each year. We cannot, and must not, ignore these new radiologists, since they will be the leaders ten years hence. They must be cultivated as soon as they enter the specialty, for two very excellent reasons: (1) that their allegiance and cooperation may be won for organization work; (2) that their first efforts and their development into specialists may be rightly directed.

There is some tendency to the idea that we have organized as a defensive move against the practitioners who would like to become radiologists and who are advancing gradually toward that worthy ambition. Such an attitude on our part should be unreservedly condemned. This country needs many more radiologists, not so much in the larger cities as in communities of moderate size. This need can best be supplied by the general practitioners who make the transition gradually from general work to radiology, and there should be a highly developed department of our organization which will seek out and encourage the men who are entering the specialty from the ranks of general medicine. In a medium sized community from 10,000 to 50,000, it is not essential that a radiologist devote all his time to the specialty. The College of Surgeons developed the right idea when they laid down their qualifications for a recognizable surgeon, these providing that the ratio of surgery to the

* Read before the Annual Meeting of the Radiological Society of North America, at Detroit, December 4-8, 1922.

.l work of the doctor might grade down in proportion he size of the community in which he practices. As long our society is proud to accept as members, eminent derma-gists, surgeons, internists, eye, ear, nose and throat spe-ists, orthopedists, gynecologists, who use radiology merely an adjunct to their work, we should not cavil at the gen-l practitioner in a small city, who is conscientiously trying supply the demands of his community for reliable x-ray rk.

One problem, whose solution is possible, is the securing adequate information as a basis for organization activity. is can be done by a properly developed Bureau of In-mation, which should gather data not only about all estab-ed radiologists, but also about those who are, as yet, y in the transition stage. The following rough figures l illustrate the need for such information. There are, in United States and Canada, at least 815 cities with ulations over 10,000. There are 237 communities of re than 10,000 population without a radiologist regis-ed in the A. M. A. Directory; in these 237 communities re are more than 300 hospitals of more than 50 bed ca-ity. These figures take no account of cities which list n one radiologist, and since many hospitals in large cities ve no radiologist, there are certainly many more than 300 pitals of more than 50 beds without qualified radiologists. e information desirable should embrace the following, at st:

(a) Name of every radiologist now practicing in the ited States or Canada, his qualifications and his hospital nections.

(b) List of all hospitals in the county, their size d type of organization; their x-ray equipment and method conducting x-ray departments.

(c) The number of doctors in each community of re than 10,000, and the general nature of the medical surgical work of the community.

(d) The demand for radiologic facilities in each of se communities and how this demand is being met.

(e) Names and locations of all men doing radiologic rk and not connected with hospitals, together with the neral attitude of the medical profession of their communi-s toward radiology as a medical specialty.

With this information in hand, the central organization n intelligently and effectively assist the various state coun-lors in propaganda and educational work.

PROPAGANDA

With regard to these actual and potential radiologists, us visualize a definite policy of education and coopera-n, endeavoring to see that they receive the support of eir confreres and that their work is recognized and de-loped. An excellent pprecedent for this type of propaganda to be found in the work of the late Dr. McCormack, for e American Medical Association, and a bit of history hich developed from his activities is given to illustrate this int. Some ten or twelve years ago, he visited a western ty, cultivated the acquaintance of the doctors during sev-al days and then addressed the county medical society. e emphasized the advantages of cooperation, of study, of stgraduate work, of specializing when the community de-ands it, finally suggesting that some young doctor be en-uraged to engage in clinical laboratory work, a most ident need in that community. This advice resulted in a ctor who was an indifferent success as a general practi-ner, taking up first the clinical laboratory work and, later, e x-ray work for the community. Through the legitimate mands of the profession, created by persistent and per-ctly ethical educational propaganda, large laboratories r these two specialties have developed, and all independent -ray machines have been discarded in that city. Of more portance, when the hospital tried to follow the recommendation of the College of Surgeons and operate a newly installed x-ray department with a "trained technician," the staff surgeons refused to cooperate until the x-ray work was placed under a consulting radiologist. This bit of history is given solely to illustrate three things which are problems of our propaganda work: (1) the successful development of high-class radiology in a small community; (b) the education of the doctors to cooperate with the radiologist and support him whenever he convinces them of the superiority of his work and agrees to furnish the service at a financial saving to them; (3) the instillation of the knowledge into the general profession and hospital managements that radiology is not a technical affair, but a specialized branch of clinical medicine.

The successful solution of the problem involving the development and maintenance of radiology as a medical specialty lies in education of the medical profession. It is not to be solved by resolutions and conferences among ourselves. It has no reference to the attitude of the individual radiologist toward his own work. It is taken for granted that every radiologist regards himself as a medical specialist and insists on performing his work as a consultant. What is needed is to bring the general profession to the realization that the interpretation of pathology, and not technical procedure, constitutes the work of the radiologist; that such interpretation requires a high degree of medical knowledge. There is no idea, here, of criticising the physician or surgeon who uses an x-ray technician for mechanical and technical details while he, himself, makes the interpretations from x-ray shadows or prescribes his x-ray treatments. Such a man is no more to be criticised than is the general practitioner who performs his own surgery, and often does it well. The situation regarding which we have just grievance is created by the attitude of our great medical and surgical organizations, their ideas being reflected in the general professional body.

In one of the large mining camps of Arizona, some years ago, before the medical examining board came into existence, there was a mulatto "doctor" in charge of the mining hospital, conducting its medical and surgical work. At one of the medical banquets of those pre-Volstead days, this man, with alcoholic candor, admitted that his entire medical training consisted in acting as a coachman for an eastern surgeon during several years; he held his position as mine surgeon by calling in consultants for difficult cases. This bizarre frontier experience is past history with us and could not now be repeated, but in many sections of the country, conditions exactly similar are taken as a matter of course. In Chicago, for example, non-medical men are permitted to take charge of important hospital departments and these laymen are called in consultation by eminent clinicians and surgeons of that city, which aspires to be the medical hub of the world. We learn, in the case of one so-called "radiographer" with important hospital connections, that his medical education was acquired by acting as janitor in an x-ray laboratory. Wherein is this any improvement over the negro coachman acting as a surgeon? The fundamental medical knowledge necessary to make a proper x-ray examination of the abdomen and give a correct interpretation of gastro-intestinal pathology, is as great as the skill required to remove the appendix surgically. It is reported that a famous Chicago surgeon, now dead, had in his surgical laboratory, an attendant who could perform any requested operation, with a celerity and skill which was the wonder of all visiting surgeons. Had he, because of this technical ability, tried to practice surgery, he would promptly have landed in jail. Yet, such a man's right to practice surgery is, in every respect, equal to the right of laymen to diagnose and treat diseases with x-ray. Further, to refer patients to

this knife wielder would be no more reprehensible than to send them to the operator of the x-ray machine.

There is a very striking inconsistency in the attitude of great medical organizations toward the relationship between radiologists and lay radiographers, as compared with their attitude toward exactly similar relationships in other specialties, e. g., those between the ophthalmologists and opticians. The American Medical Association has been avowedly, and properly, against the practice of medicine by opticians, but has actually lent encouragement to the practice of medicine by x-ray photographers. A non-medical man practicing radiology bears exactly the same relation to medicine as does the optician who diagnoses and treats eye diseases. The only difference is that the optician usually has had good training and confines his work to a limited field, while the radiographer, with no medical training at all, covers the whole range of clinical medicine. The opticians are outlawed by all medical organizations, doctors who refer patients to them are censured; hospitals are closed to opticians; they cannot advertise in medical journals, and their efforts to secure legal recognition are always opposed by medical organizations. On the other hand, the x-ray photographers are given charge of hospital departments with the approval of dignified medical bodies; they operate laboratories for the diagnosis and treatment of disease; they advertise in state medical journals whose pages are vised by the American Medical Association; in one state, when they sought legal recognition, they were actively supported by the state medical society, which assisted them to form an organization, invited them to hold a sectional program at the annual society meeting, and took them into the official medical body *as associate members*. A bitter fight on the part of the radiologists of the state finally forced the society to rescind their action, in part, but even today, the officials of that medical body do not admit that they were in the wrong.

One of the requirements of the Minimum Standard for Class A hospitals is that there shall be an x-ray department equipped for diagnosis. The nature of this equipment is not specified, except that the department is not required to have a medical head—a "trained technician" being considered sufficient. The clinical laboratory is required to have a pathologist in consultation, because tissue pathology requires a medically trained eye, whereas, presumably, gross pathology as shown by the x-ray film, does not. This idea of an eminent surgical organization has good legal support, since the supreme court of Iowa has said that an x-ray film brought into court, does not need to be interpreted by an expert; it shall be submitted to the jury without comment, because, in the words of the judge—"an x-ray photograph carries with it its own interpretation."

Can we ever hope to overcome so universal a misconception of what constitutes the practice of radiology? It is believed that we can, but not without considerable work, the first step in which is to visualize the task. That task is to educate the medical profession, to permeate it thoroughly with the idea that radiology is as much a medical specialty as surgery or obstetrics. The place which our work holds in the estimation of the profession is due, purely, to lack of correct information. We can trust our profession to act justly, when it is correctly informed.

One of the definite things which we can do is to see that every medical society in the country, large or small, whenever it meets, shall have a representative from this society presenting the facts of radiology. Not only in scientific meetings, but in organization conferences, we should have spokesmen and delegates, leaving always the definite impression of the significance, importance and dignity of radiology as a medical specialty. This type of work cannot be safely left to individual initiative, but should be a department of our organized activity. Whenever there is a radiologic section of a larger medical organization, every member of that section should exert a weighty influence in sectional meetings. It is questionable whether radiologic sections of general societies are advisable, at the present time, since they are likely to self center our work. It is much better, from the educational angle, for us to make presentations before other sections, and we should see that they always have worthy papers on radiology.

We should continue and intensify our efforts to secure, through the College of Surgeons and other interested organizations, a recognition of the necessity for having the x-ray departments in charge of medical radiologists. It is, of course, not necessary or desirable that the technical work of making films be personally done by the radiologist, any more than it is necessary that the surgeon be required to shave and scrub his patients before operating them. But, whenever a diagnostic interpretation is to be made, or an x-ray treatment outlined, a physician trained in radiology should be called on for such diagnosis or prescription. Such a standard, set by the College of Surgeons, supplemented by this and other special societies, could be met, in small communities not now supplied with a radiologist, by encouraging some local practitioner to make the necessary study of the subject which will entitle him to speak with an authority above that of his confreres in x-ray interpretation, thereby giving him charge of the consultation work for his hospital and community. Frequently this can be done by combining the x-ray and clinical laboratory departments under one head. It is no wild dream to imagine this society sending a representative, following the example of Dr. McCormack, or the present-day representatives of the College of Surgeons, to lecture the hospital staff about the proper relationship of radiological work to other medical and surgical work, and even to induct some practitioner of the community into the specialty. Along this same line, it seems that some of the resources of the organization could well be employed in establishing and conducting a school of instruction for medical men who desire to secure sufficient training to handle the x-ray work of small communities. The technical principles and essentials of interpretation could be given in a short time. This sounds treasonable in the face of the teaching that it requires from one to three years to make a radiologist. It is not contemplated that a finished radiologist will be turned out in a month, but that sufficient foundation can be laid in this time to enable an intelligent general practitioner to follow up the work in his own practice.

This discussion is presented to this body because it is not good for us to become too satisfied with our organization. Our society has grown rapidly and is destined to become a power in medical affairs in this country, but a *laisser faire* attitude at this time would be a calamity. Not until we have comprehensively organized the radiologists of the entire country, not until we have brought the profession to a thorough realization that radiology is practicing medicine as a specialty, and have the weight of the general medical organizations solidly behind that idea, can we safely relax our efforts. The study of radiology as a science and art has, heretofore, claimed a disproportionate share of our attention, and it is now time for us to direct our chief efforts into other essential lines of development.

W. Warner Watkins, M.D., F.A.C.P.

European Visitors

THE following guests from European countries were present at the Annual Meeting of the Radiological Society recently held in Detroit. We were greatly pleased to have these men with us and extend to them a most cordial invita-

tion to soon come again: Dr. O. Glasser, Freiburg, Germany; Dr. Hector Paul Pilon, Paris; Dr. John Iten, Berne, and Dr. Ernest Pohle, Frankfort a.M., Germany.

American Roentgen Ray Society

THE mid-winter meeting of the Central Section of the American Roentgen Ray Society will be held in Louisville, Kentucky, February 24, 1923. A splendid program and attendance is planned by those in charge and visitors from other sections of the country will be welcomed as well.

Mid-Annual Meeting

THE Mid-Annual meeting of the Radiological Society of North America will be held in San Francisco, June 22 and 23. The hotel headquarters will be at the Palace, and the meeting will be held in the Civic Auditorium.

CASE REPORTS

Gastric Polypus and X-Ray Demonstration of the Same

J. P. McCULLOUGH, M. D.
Pittsburgh

THE malignant tumors occupy such a prominent position in the study of tumors of the stomach that the study of benign tumors appears to be neglected. This is largely due to the relative infrequency of occurrence of the latter.

Benign growths of the stomach have been classified as polypi, adenomata, lymphoadenomata, myomata, fibromata, myxomata, lipomata, osteomata and cysts; from a pathological and from a surgical standpoint some of the most interesting features of these benign tumors are associated with polypoid growths.

In a review of the literature on benign gastric tumors, Campbell in 1914 mentions the frequency as reported by Tilger to be 14 in 3500 autopsies. He quotes another writer as reporting four gastric polyps in 7500 necropsies. While Basch in 1915 mentions Ebstein's findings to be 14 gastric polyps in 600 necropsies. Thus, there appears to be considerable difference of opinion as to the frequency of occurrence of the benign gastric tumors, particularly polyps.

In 1914 Campbell made the following statement: "It is interesting to note that the diagnosis of benign tumors has rarely, if ever, been made before operation." Campbell at that time emphasized the fact that the rapid development of radiological diagnosis promised to be more valuable in the diagnosis of these tumors than any other means short of acual demonstration of the growth itself.

In 1914 Stoner presented an article, reporting a case and mentioning the fact that the ages of two patients whose cases had come under his observation were 34 and 36 years, the youngest patients reported with benign tumors up to 1914.

The following year, 1915, Basch reported three cases as follows: The first case was seen in 1912. In this case the x-ray examination revealed a defect suggestive of tumor which after removal proved to be a papillary adenoma. The defect noted was a persistent knob-like projection into the lumen from the middle of the greater curvature. In the second case the radiogram showed a large circular defect at the junction of the pyloric antrum and pars media, the defect was characterized by a mottled appearance such as Myer described in a case of polyposis in 1912. Operation revealed a pedunculated mass two and one-half inches in diameter, not far from the pylorus. The radiogram of the third case showed defects resembling finger prints in the region of the pyloric antrum. This case proved to be a papilloadenoma.

Since 1915 the development of radiological diagnosis has been rapid and the report of cases of polypoid tumor before operation should be less infrequent than formerly.

Of the classification mentioned above mucous and adenomatous polypoid growths are probably found more frequently than the others. They resemble each other very much in structure: true adenomata being made up of more or less tortuous, dilated, tubular glands, supported by connective tissue and well supplied with blood vessels. They form rather firm smooth rounded or somewhat lobulated tumors, occasionally cystic in part, the cyst being filled with mucous. The size ranges from that of a walnut to that of a fetal head.

Menetrier in 1888 described two form of adenomata, and his description is frequently referred to as presenting the most accepted classification. He described a superficial form, involving the execretory ducts and associated with lobulation, and a deeper form involving the glandular structures and presenting little or no lobulation. When they occur singly as a solitary polyp or multiple polypi, he applied the term "polyadenomes polypeau," and where they occur en masse, the term "polyadenomes en nappe" is used.

Ruggles in a report of a case in 1917 stated that only four cases of polyposis (polyadenomes en nappe) had been reported since Menetrier's article in 1888. Carman has seen two cases of polyposis in 50,000 examinations.

Balfour reported in 1918 a case of polyposis, which corresponds to the "polyademomes en nappe" of Menetrier, and he expressed the opinion that polyposis is a separate entity from single polyp.

In 1920 Novak of Johns Hopkins reported a polypoid adenoma removed

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, December 4-8, 1922.

by gastrotomy during an operation for cholecystitis, at which time palpation of the stomach revealed a small mass there. The sketches presented in Novak's article demonstrate the operative findings in the case, which furnished the incentive for this review of literature with one exception; namely, that the writer's case presented a tumor considerably smaller than that of Novak, its location and other characteristics resembling Novak's case.

Of the more recent articles published discussing polypoid growths within the stomach is one by Merrill in the Boston Medical and Surgical Journal, February 17, 1921, and another by Eusterman and Sentry in Surgery, Genecology and Obstetrics, January, 1922.

Merrill here presents a case of polypoid adenoma in which the x-ray examination revealed a rounded, slightly mottled shadow displacing the barium contents without completely filling the gastric lumen. It presented no interference with peristalsis, and there was no impairment of flexibility of the gastric wall. The tumor was superficially lobulated, giving the x-ray shadow a reticulated appearance. Hemorrhage was apparent as one of the clinical symptoms.

From the fact that most of the cases which have been reported previous to 1914 15 have been found accidently during operation for other conditions within the abdomen or at autopsy, there is no doubt that many cases have passed unrecognized and not observed because of lack of operative or postmortem findings. Many of the cases reported within the last six or eight years have been brought to the attention of the surgeon by x-ray examination.

The occurrence of polypi is noticeably infrequent, and from the study of the literature and reports of cases, no definite etiological factor seems appraent. Basch states that the causes assigned include chronic alcoholism, chronic gastritis and atheroma of gastric vessels. Carman says that there is nothing in the clinical or physical examination of his cases which would establish a diagnosis or differentiate them from other organic or functional diseases of the stomach. The three cases reported by Basch presented no symptoms which could be considered characteristic. Signs and symptoms common to all gastric disturbances and pathognomonic of none in particular seem to be present in the symptomatology of cases reported.

In simple pedunculated growths the symptoms seem to be of less consequence than those of the polypoid mass formation. The growths may be present throughout life and give rise to no symptoms, and they have been discovered often at operation, sometimes accidently when operation was performed for other disorders. On the other hand their presence may be frought with great danger to health and life. A polyp located near the pylorus and having a long pedicle is apt to prolapse into the pylorus and be associated with pain, nausea and vomiting. Such obstruction is said to be intermittent with intervals of good health between attacks.

A natural cure may result by separation of the polypus from its pedicle through torsion or strangulation of the latter. It may, on the other hand, result in prolapse of the gastric wall into the duodenum, producing gastro-duodenal intussusception. Such a case was reported by Wade in 1913.

Hemmorhage is a very important condition which may result. Miller, quoting Fenwich on "Cancer and Other Gastric Tumors," states that in ten per cent of all gastric tumors there is hemorrhage and that it may be serious. He says also that an important fact in connection with adenomata is that pathologists generally admit that adenomata have a close association with malignancy.

Miller summarized the study of his case of polypoid carcinoma as presenting the following interesting features:

1. The occurrence of an anemia (eighteen months before the patient's death) of such a degree as to suggest primary pernicious anemia and which was probably dependent upon hemorrhage from a primary benign lesion.

2. The probability that malignant change was secondary to a benign tumor.

3. The polypoid nature of the tumor without evidence of involvement of the deeper structures of the wall and yet unquestionable metastasis.

Here is a case which appears to have been a benign polypoid growth, which gave rise to serious hemorrhage and showed malignant degeneration and metastasis without involvement of the gastric wall. The x-ray evidence in this case is described by Pancoast as a permanent defect in the dependent portion of the greater curvature of the stomach. The x-ray report further states that the gastric lesion was probably a papilloma, although he suggests the possibility of carcinoma or sarcoma.

The following case came under the observation of the writer in 1920: A woman, age 23. Personal history: She had had typhoid when 4 years of age, measles and chicken pox in childhood, and in the early part of 1920 had had a mild attack of influenza. The chief complaint at the time of examination was pain under the right shoulder and pain in the right iliac fossa, the pain radiating from the epigastrium. The pain under the right shoulder was most annoying before arising, usually about 5 or 6 a. m., the pain in the epigastrium most severe in the morning. No pain during the day. No nausea, no vomiting. Pain had no relation to eating. Pain in the right iliac region was rather indefinite and rather infrequent in occurrence.

X-ray examination of the stomach revealed a rounded defect in the stomach shadow about one to one-half centimeter in diameter, located in the pyloric region near the lesser curvature and just distal to the angularis portion of the lesser curvature. There was no impairment of peristalsis nor any interference with the flexibility of the gastric wall. No interference with the emptying of the gastric contents into the duodenum. The stomach emptied in four and one-half hours. No evidence of intestinal or colon pathology. The appendix was rather long, freely movable and showed no evidence of pathology. X-ray diagnosis was gastric polyp.

Operation: Appendectomy and gastrotomy. The tumor and its pedicle were removed, and presented the following appearance. A small almost round ball of tissue measuring one and one-half by one centimeter, fairly firm, beefy in color. The surface had a cauliflower like appearance, the pedicle measured two centimeters in length and was three millimeters in diameter.

Section of the growth showed a thin central fibrous core, carrying small blood vessels, and from the core radiated strands of tissue like spokes of a wheel. These strands were pinkish gray in color, cellular and moist.

Microscopic examination showed the strands of radiating tissues to be glands considerably hypertrophied in which there was hyperplasia of epithelium. The tumor mass presented a similar tissue appearance under the microscope. Some of the glands had a cystic appearance and contained mucous. There was considerable round cell infiltration. Pathological report: Mucous polypus.

Reviewing the x-ray appearances produced by benign growths, particularly those pedunculated, it is noted that a defect in the gastric shadow is usually present. This defect varies in appearance apparently according to the size of the mass, its location and the length of the pedicle.

In cases of polyposis the polypoid masses present a diffuse mottling due to displacement of barium by these

masses and giving a reticulated or honeycombed appearance. The size of such an area being dependent upon the extent of involvement.

In the single polypoid growths the x-ray appearance varies from fingerprint defects to rounded, sharply outlined defects, which may or may not show a mottled appearance accordingly as the surface of the growth is nodular or smooth, as in the cases cited by Basch. On the other hand, the defect may by virtue of an irregular outline or lobular surface present a correspondingly irregular outline defect.

On account of the small surface of involvement from a small pedicle attachment permitting of free peristaltic action and because of no impairment of gastric wall flexibility, also from the fact that pedunculated masses have a certain degree of movement within the stomach, they resemble the appearance of retained food material or foreign bodies and care must be exercised to differentiate in this respect.

The dangers of gastric polyp, particularly those of mechanical production, hemorrhage, and possible malignant degeneration make the early recognition of these conditions imperative.

The x-ray offers the best means of early diagnosis of gastric tumors, pedunculated or otherwise.

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Healed Renal Tuberculosis

C. C. BIRKELO, M. D.
Detroit

ONE of the cases here recorded is the first case of its kind ever published, as far as we are able to find out from the literature. The others, although they represent various anatomical locations, are also sufficiently interesting and rare to justify this report. Each case is briefly outlined because each is self-explanatory.

Healed Renal Tuberculosis

We lack proof that renal tuberculosis has even healed, but it is because we believe this case represents a healed renal tuberculosis that we report it.

Brasch speaks of autonephrectomy causing a possible healing. Chute believes that many small renal tuberculous lesions heal in the kidneys as elsewhere and escape unnoticed; however, we lack the evidence which would prove this view.

Case 1. Male, age about 55. Came to the laboratory for blood sugar determination, and the doctor requested that we fluoroscope patient to see if there was any fluid in the chest. While doing this we observed a shadow resembling a kidney in the left abdomen and a single roentgenogram was made, which showed diffuse calcification of the kidney.

About one month previous to this examination the patient had been operated on for an acute appendical infection and an abscess was found about the appendix. An ascending infection set in involving the pancreas and large amounts of sugar had appeared in the urine. It was for this condition that examination of blood sugar was made at the laboratory, when we accidentally discovered this diffuse calcification in the left kidney. Any further attempt at examination of this patient was refused, and he also refused further treatment of his diabetic condition. He attempted to return to England, but died in coma on the way.

This patient gave no history of hematuria or pains in the region of either

kidney and had apparently enjoyed good health except at the age of 12, when he had been sick for about a year, when it was thought that he had kidney disease. He had had no known recurrence of this condition since then, nor did he remember any pain in the left abdomen. There was no mistake about the diagnosis of appendicitis, as an abscess was found, and it was following this that sugar appeared in the urine. From this history it appears that the process must have started at the age of 12, and as it gave no further symptoms for the next forty years, we think it would be only reasonable to consider the process healed.

Calcification of the Visceral Pleura

Case 2. We have here a case of diffuse calcification of the pleura with no history of any tuberculous infection in the lung, but a diagnosis of tuberculous peritonitis has been made and we find calcareous deposits below the diaphragm on the same side as the calcified pleura. We believe it is the result of a tuberculous infection, and if so, both must have healed, because patient is free from both pulmonary and abdominal symptoms and has been for the last two or three years.

History: Mr. L. A. P. Age, 41. Family history, negative. The patient had a severe attack of pneumonia at the age of 7 and remained in poor health for three years. Six months in the woods of the northwest seemed to make a change for the better and he began to grow. Since then he has had no lung trouble until three years ago, when he had a light attack of the "flu." At the age of 28, however, he had typhoid fever, which he states was followed by jaundice and abdominal pains, which were diagnosed as due to tuberculous peritonitis. He has had slight digestive disturbances on occasions. We made a gastro-intestinal study on this patient about two years ago and this was negative except that it showed a few calcareous deposits below the left diaphragm which led to the discovery of the calcification in the pleura. Stereoscopic roentgenograms show dense calcium deposits in the pleura over nearly the entire lower left lobe, outlining definitely the pleura and showing that it has retracted from the chest wall.

There is no evidence of any tuberculous process in either lung, and, therefore, the calciferous condition in the pleura must have been the consequence of an old pleurisy possibly secondary to a tuberculous peritonitis.

DEPARTMENT of TECHNIQUE

An Aluminum Cassette For Use in Pfahler's Method of Examination of Sphenoid Sinuses

JOSEPH ASPRAY, M. D.
Spokane

I HAVE FOUND the vertical method of examination of the posterior ethmoids and anterior portion of the sphenoids very valuable. An aluminum cassette to hold film and screens makes the method comparatively easy.

The cassette is made of thin aluminum 3/8" by 2¾" by 5", the front end being rounded, and the other end is open. A piece of cardboard is made to fit this cassette and protrudes from the open end about an inch.

Before placing the cardboard in the cassette a flap of orange paper is fastened about three and one-half inches from the inside end. We have two intensifying screens, one of which is fastened to the cardboard and the other to the flap. The duplitized film cut to fit, is placed between the screens and the entire filling is placed in the cassette with cardboard on the bottom. A lead letter "R" is fastened to aluminum top on right.

This cassette, properly loaded, is placed as far back as possible in the mouth, the patient breathing through the mouth. Out of over a hundred cases we have yet failed to see the patient who would not tolerate it.

Have patient lie upon the back on a four inch hard pillow, head straight, with a three inch cone centered so that the edge of the cone is near the head, and on a level with the anterior portion of forehead. The technique used on cassette, in the position used when is as follows: 90 degree angle, $4\frac{1}{2}$ inch spark, 25 ma., $2\frac{1}{2}$ to 3 seconds exposure.

Posterior-anterior-oblique Examination of Sphenoid Sinuses

FOR the past year and a half I have been using the following methods in the examination of the sphenoid sinuses, along with the usual lateral and vertical methods.

The patient is placed with forehead radiographing the frontals. The tube is angled upward ten degrees, a three inch cone is used and this is centered over the foramen magnum. Our technique with double screen is $4\frac{1}{2}$ inch spark, 25 ma. and 5 seconds.

This will throw the sphenoid superimposed upon the frontals, and in the majority of cases shows the sphenoid sharply outlined. The size of each side and the densities can be definitely judged.

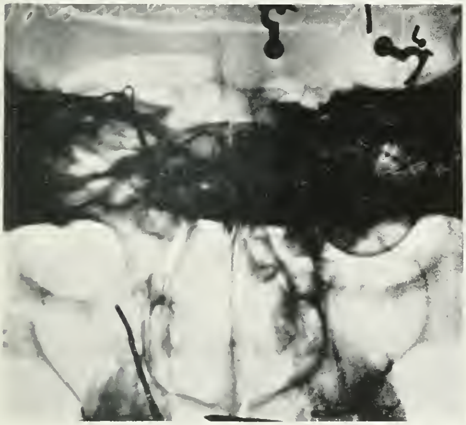

Fig. 1—Sphenoids of different densities.

Fig. 2—One side of sphenoid filled with lead. Lead ring around foramen magnum.

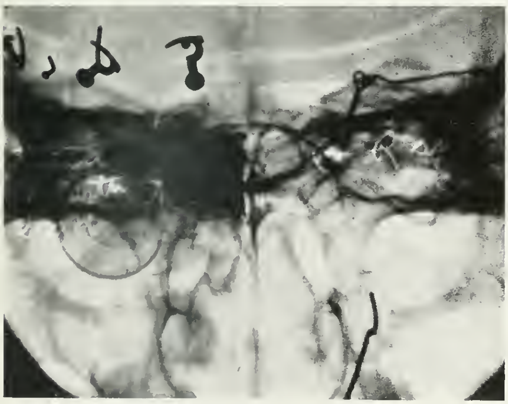

Fig. 3—Left sphenoid filled with lead.

Fig. 4—Right and left sphenoids.

ABSTRACTS *and* REVIEWS

Unusual Case of Exudative Calcifying Fasciitis with Extensive Calcareous Intermuscular Deposits. Harry Lowenburg, M. D., Pennsylvania M. J., 26:21, October, 1922.

THIS rare case is described in detail and illustrated by accompanying radiographs. Apparently it is unique, since an imposing list of consultants are mentioned, none of whom had ever encountered such a condition. The calcification follows the fascial planes and does not involve the musculature, so that myositis ossificans is excluded At the present time, two years after patient came under observation, the calcification has spread over almost the entire body. W. W. W.

A Case of Paltauf-Sternberg Lymphogranuloma in the Ilium: Roentgen Ray Demonstration. A. Grossman *and* Weis-Ostborn, M. D., Fortschr. a. d. Geb. d. Roentgenstrahlen, 29:569, July, 1922.

SINCE Sternberg distinguished the clinical and anatomical entity of lymphogranulomatosis from the rest of the group designated by the name of pseudoleukoemia, a number of such cases have been described. Because these granulomas present changes similar to those found in tuberculous glands there arose a difference of opinion as to the causative agent. Reed, Coley, and Ziegler ascribed the tuberculous changes to a secondary tuberculous infection. Fraenkel and Much isolated gram positive, antiformin fast, granulated bacilli, which, however, were not acid fast. Cases of granuloma in almost all parts of the body were reported. The authors' case is one of granuloma of the ilium.

The patient was a woman of 30 whose two sisters had had enlarged glands in the neck, and one sister had died of a malignant lymph gland tumor in the mediastinum. At the age of 27 the patient had a swelling of the glands of the neck which disappeared by radiation. At the time of this report she had enlarged glands in the neck, axilla, and groins with loss of weight and anemia. She complained of severe pain in the left hip and leg, and had a rise in temperature. Examination revealed a mass in the region of the left ilium. The blood picture was normal except for a low hemoglobin index and 18,000 leukocytic count.

Roentgen ray examination revealed an oval area of rarefaction in the left ilium with irregular invasion of the edges. There was no periosteal reaction.

After a number of radiations, which only slightly affected the course of the illness, the patent died, and a histopathological examination established the diagnosis of lymphogranuloma.

The appearance of this disease in bones is interesting because of the ease with which it may be demonstrated roentgenologically. A. M. P.

Pathology of Ostitis Deformans, Paget's Disease. Sydney M. Cone, M.D., J. Bone and Joint Surgery, 4:751, October, 1922.

THIS is a detailed pathological study of the bones, tissues and organs of the case of Paget's Disease reported from the clinical standpoint by Hurwitz in the Johns Hopkins Bulletin, September, 1913. The patient died in December, 1920, and autopsy was performed, the result of which forms the subject of this paper.

The bone changes vary in the different bones and in varying parts of the same bone, apparently this is due to changed static and circulatory conditions. The degenerative changes in the vessels of the bones are out of all proportion to the degenerative changes elsewhere in the body. Many vessels are occluded by hyalin and vascular thrombi. Some appear ossified, others fibrosed and incorporated in the newly formed bone. The erratic formation of bone is remarkable. Bone absorption is taking place both by lacunar absorption and by fluids. New formation has ceased for the greater part. There are a few new osteoid deposits, covering Howships lacunae, and lining trabeculae of older bone. A characteristic feature is new formation and disappearance of new bone; there is a granular condition with widened lacunae and enlarging multiplying bone cells in the bone lining the canals. The marrow of clavicle and tibia is replaced by fibrous and myxomatous tissue.

It is not possible to abstract this article in its entirety. It will repay careful reading as a basis for interpretation of radiographic findings in such cases. W. W. W.

Ultraviolet Radiation in Rickets. (A compiled study), A. J. Pacini, M.D., Reprint abstracted by author.

THIS presents a study of authentic literature having to do with the ultraviolet therapy of rickets. It gives the title, author, and citation of twelve papers with the author's conclusion in every case, together with a comment by the compiler of the study.

Following this a method is advanced for the use of ultraviolet radiation such as will insure maximum application of the various principles propounded by the studies involved in the compilation.

Author's summary is as follows: (1) An abstract summary of the recent studies on the use of ultraviolet energy is submitted. (2) The ultraviolet region responsible for the proved therapeutic action in rickets is established. (3) The method for obtaining this necessary region at its maximum value is given in the choice of the lamp (air-cooled) the required tube voltage operation (70 volts); the necessary distance from tube to naked skin (40) inches. (4) The average exposure time for various subjects is given, together with a rule for determining the time and frequency of each subsequent exposure. (5) When other than tangential exposure is used, the necessary fraction of time increase depending upon angle of ray incidence is given.

A. J. P.

Studies of the Selective Ultraviolet Radiation in the Prevention of Experimental Rickets. A. J. Pacini, M.D. Reprint abstracted by author.

THE first part of the study is devoted to an appraisal of the intensity of the ultraviolet fraction of sunlight at different points of observations. The material is gathered from the data furnished by the Smithsonian Institute.

The second part of the study has to do with a comparison of the ultraviolet spectrum, as produced by the air cooled lamp, and the actinic spectrum of sunlight. The active region of the mercury vapor lamp spectrum is assumed to be that portion occluded by glass and terminating with the limit equivalent to the furthest extreme of the sun's spectrum. This means, in angstrom units the ultraviolet wave lengths of 3022, 2967, 2925 and possibly 2894.

Various filter materials that permit the passage to similar limited regions were tested against experimental rats fed on the McCollum diet; from which it is learned that the active therapeutic region of the spectrum is included between the wave lengths 3022 to 2900 angstrom units.

The author's summary is as follows: Data and experiments are presented showing (a) the limits of ultraviolet wave lengths in sunlight preventing experimental rickets (from 3022 to 2900 angstrom units). (b) The loss of ultraviolet intensity of solar radiation incident to season, time of day and altitude. (c) The limits of ultraviolet wave lengths from the mercury vapor arc in quartz effective in preventing exxperimental rickets (from 3022 to 2654 angstrom units). (d) A method for procuring desired selected wave lengths from the quartz mercury vapor arc through the use of especial filters.

A. J. P.

Ultraviolet Energy in Diseases of the Bone. A. J. Pacini, M.D. Reprint abstracted by author.

IT APPEARS definitely proved that ultraviolet energy exerts an increase in the calcium and phosphorus content of the blood.

Considering the various diseases of the bone in which a perversion of calcium and phosphorus metabolism is essenfially involved, the application of ultraviolet energy is recorded with favorable findingsg in cases of osteoporosis from whatever cause, rickets, achondroplasia, osteogenesis imperfecta and osteomalacia.

Author's Summary

1. Reference is made to the proved property of air cooled ultraviolet energy (biologic) in increasing the calcium and phosphorus content of the blood and serum.

2. There is an important "special formula" required to effect this property; to obtain which the tube voltage (70 volts), tube-skin distance and exposure factors for various individual types are offered.

3. Conditions treated with striking clinical improvement include osteoporosis, rickets, achondroplasia, osteogenesis imperfecta, osteomalacia.

4. X-ray evidence of bone radiolucency indicating osteoporosis from whatever cause is a clinical index for the use of ultraviolet energy.

A. J. P.

The Roentgenogram and the Therapeutic Indications in Tuberculosis of the Bones and Joints. F. DeOuervain, M. D., Schweiz med. Wchnschr., 52:1021. October 19, 1920.

GENERAL points observed in the roentgenogram:

1. A diffused osteoporosis in absence of primary trophoneurotic disturbance generally indicates the presence of some organic disease of the particular bone.

2. If bone defects are present, an indistinct outline of the defective area and obliteration of the normal bony structure indicates a recent and still progressing lesion; good calcified deposits, an osteosclerotic zone about the lesion, smoothing of defect, and the reappearance of normal bone structure indicate an old lesion in the healing process, or even a healed lesion.

3. In tuberculous processes the periosteal reaction is of but little importance, so that its presence or absence is of little significance in the further course of the disease.

In the consideration of the lesions of the vertebrae, ribs and the hip, knee and ankle joints the author found the following:

Vertebrae: The therapeutic indications cannot be based upon the roentgen findings. Some cases with positive x-ray findings could be allowed to go about freely, while others with no findings had to be immobilized. The hazy appearance and abnormal tranlucency of the vertebra indicates the presence of the lesion. The treatment is mainly climatic and orthopedic. X-ray treatment is of value only in cold abscesses, while the possibility of injuring the spinal cord prevents the application of much therapy to the bone. The presence of a burrowing abscess in the roentgenogram indicates the continuation of therapeutic measures although the vertebra may appear normal.

Ribs: According to Iselin the great majority of rib tuberculosis results from an extension of a tuberculous condition of the lungs and pleurae. The diagnosis can be made by x-ray findings, and the treatment be directed to the primary cause.

Hip Joint: Operative procedures have been neglected on account of insufficiency of results. Roentgen ray treatment proved unsuccessful. Only climatic and orthopedic treatment prevail. By roentgen ray observation we follow the stages of destruction, gradual healing, calcification and ankylosis. Koenig's contention that the presence of a sequestrum requires operation is no longer held true, although its presence indicates that the process is not yet healed.

Knee Joint: When the process is limited to the synovial membrane any form of treatment, including roentgen ray, or all combined can be successfully applied. Where changes are found in the bone or cartilage resection and conservative treatment should be applied in young people. In old people amputation is the better way. The presence of sequestra indicates the absence of healing or at best clinically latent disease.

The Ankle Joint: The condition is about the same as in the knee joint, but it must be remembered that roentgen treatment in this region is more liable to injure the skin than anywhere else. The roentgen ray treatment should be applied cautiously.

Tarso-Metarsal Joints: This condition is very appropriate for x-ray treatment.

The Shoulder Joint: Roentgen ray treatment should be applied for some time, but if results are not good it should not be prolonged, but resection performed.

The Elbow Joint: Here also there are two types—the synovial and the bony. The conservative treatment including x-ray should be continued for some time before other measures are applied.

The Carpal Joint: What was said about the tarsal joints applies to carpal joints also. The same is also true of spina ventosa.

A. M. P.

Cervical Rib. Samuel W. Boorstein, M.D., J. Bone and Joint Surgery, 4:687, October, 1922.

THIS author reports six cases of cervical rib, and quotes Honeij's observation that there are two interesting groups of cases in this connection; those that have the symptoms and do not show the ribs, and those without symptoms who do show ribs. The author adds the group who have the symptoms and do show the ribs. The symptoms are those of the local tumor, nervous symptoms, vascular symptoms, and muscular symptoms. The differential diagnosis is discussed with reference to the following: Arthritis; anterior poliomyelitis; Erb's palsy; subdeltoid bursitis; scoliosis; callus formation from fracture; neuritis; torticollis; exostosis; tuberculosis of cervical region; a cervical rib must be thought of in any case of sensory nerve symptoms along the distribution of the lowest branchial nerves, paralysis of the intrinsic muscles of the hand, vasomotor changes in the hand, and tumor or subclavian pulsations in the region of a cervical rib.

Stereoradiographs should be made. It is said that every enlargement of the transverse process of the seventh cervical is really a rib. In the six cases reported the x-ray examinations were all positive either for definite ribs or for other abnormalities associated with this deformity.

W. W. W.

Bone Atrophy. Barney Brooks, M.D., Southern M.J., 15:823, October, 1922.

THE ATROPHY of bone which follows non-use is not due to a decalcification, but to a thinning of the entire bone. The bone which is left has the same chemical composition as the normal bone so that lime salts have not been diminished, the bone is simply smaller and thinner than normal. These bone changes begin to make their ap-

pearance within a few days after cessation of function. In experimental animals well marked changes are present in ten days, and are very marked after ten or twelve weeks.

Bones return to normal very slowly, if ever, after a long period of non-use. This should be remembered in treating fractures. Function should be suspended for as short a time as possible, else the recovery from the treatment will be as difficult as the healing of the fracture. Restoration of function should be the primary object of treatment and not simply the union of the broken bones.

W. W. W.

Roentgenological Contribution to the Diagnosis of Spinal Carcinoma in Cases Having an Unrecognized Primary Focus. Thomas Scholz, M.D., New York M.J., and M.Rec., 116: 566, November 15, 1922.

TWO very instructive cases are recited in detail, both showing fatal metastases from comparatively insignificant primary lesions. Early diagnosis of such lesions is to be arrived at by careful attention to the one symptom, pain, and by roentgenological examinations of the entire spine and other bones of the skeleton. In one of these cases, diagnosis was not made until two years after the onset of the pain; the primary focus was in the thyroid, and metastasis was in the lumbar spine. This case was characterized by long periods of remission, various methods of treatment being given credit for these remissions. The second case went eighteen months before diagnosis was made, there being a general carcinomatosis from a small lesion in the breast. The failure of the spine to collapse and the presence of a round gibbus at tumor site are the x-ray characteristics, differentiating the lesion from tuberculosis. Repeated x-ray examinations may be necessary.

W. W. W.

Etiology of Perthes' Disease in Traumatic Hip Joint Luxations in Children. Max Rehbein, M.D., Deutsche Zeitschr, f. Chir., 174: 416. Sept., 1922.

THE AUTHOR reports a case of an 8 year old boy, of good family history and previous normal health, who suffered an upward and somewhat backward dislocation of the head of the femur on the right side, caused by a fall. The roentgenogram revealed a perfectly normal femur in a condition of sublaxation. The reduction under anaesthesia was very easy and patient was discharged with a normally functioning hip. After some time limping set in, and one year later a typical Perthes' disease was diagnosed, both clinically and roentgenographically.

There are many reports of osteochondritis deformans juvenalis following reduction of a congenital subluxation on the same side or even on the other side. But so far there has been none of Perthes' disease following reposition after traumatic dislocation.

The usual etiology is thought to be trauma, infection, and constitutional tendency, while Schwartz emphasizes trauma, believing that the deforming process of the head is due to injuries to the vessels and interference with normal nutrition.

Brandes, however, believes the disease is due to some congenital developmental disturbance, which may possibly be familial. In many cases he could find no traumatic history. In some cases Perthes' disease develops in the normal hip when the other hip has been congenitally dislocated. Iselin cut the ligamentum teres in dogs and no Perthes' resulted.

The author is inclined to Schwartz's theory that Perthes' disease results from injury to the nutritional vessels, as evidenced in his own case. He explains that the blood supply to the head of the femur may come by way of the ligamentum teres and by way of the neck vessels. There is also an anastomosis between these two sets of vessels. In view of Lorenz's findings, that in cases of congenital dislocation in the first three years of life, the ligamentum teres is absent in 50 per cent of cases, and in five years the percentage is even greater, it is easily understood that a very slight trauma or a summation of slight traumas will easily interfere with the blood supply and produce the deformity.

A. M. P.

Measurements Based on Roentgen Examination of One Hundred Normal Children. Elizabeth Schulze, M.D., California State J. Med., 20:332, October, 1922.

IN STUDYING the disorders of the pituitary, aside from the visible changes and symptoms in the accessible portions of the body, the most direct method of approach on the living subject is by x-ray study of the sella turcica and adjacent regions.

Pacini has revived the study of the so-called sphenoidal angle of Welcker, having in mind the relation of this angle and the type of sella accompanying it to pituitary disorders. The original angle of Welcher lay between two lines, one from the nasion to the turcicon, the other from the turcicon to the basion. Pacini modified this angle, choosing, instead of the last line, one connecting the acousticon and the turcicon, claiming that this is directly analagous to the sphenoidal angle of Welcher.

The author's investigations tend to demonstrate that the angle used by Pacini is too variable for accurate measurement and that it is not analgous to the angle of Welcher. The angle of Welcher was then marked out on the plates and was found to conform more closely to those given by the old anthropologists. Further studies are contemplated which will be reported upon later.

W. W.W.

Necessity for Immediate and Through Roentgenological Study of All Injuries to the Spine. Halbert W. Chappell, M.D., California State J. Med., 20:436, December, 1922.

X-RAY examination of all injuries to the back will frequently, if not usually, throw light on the nature of the injury, even if an actual bone lesion is not demonstrated. It may show a type of spine whch is more easily injured or sprained by trauma, or an actual slip in the sacro-iliac region may be shown. Fractures may occur from comparatively slight trauma. Only the routine x-ray examination will prevent frequent error in handling back injuries.

W. W. W.

Hemorrhagic Osteomyelitis. George Barrie, M.D., J. Bone and Joint Surgery, 4:653, October, 1922.

THIS very comprehensive article is freely illustrated by radiographs, and is an excellent presentation of the subject. The importance of this lesion of bone is well recognized and its benign condition established, and the purpose of the paper is to illustrate these two facts. There are still surgeons who treat this lesion as a malignant neoplasm, whereas the x-ray evidence of regenerative repair and restoration of structure which is not found in malignancies, is ignored. The neoplastic theory for this lesion rests on the presence of giant cells and there is no proof that these are tumor cells. Hemorrhagic osteomyelitis is not a destructive lesion, but nature's effort to replace tissue previously destroyed, and this replacement may proceed to full architectural restoration of the bone substance.

About 75 per cent of the solitary lesions may be traced to bone trauma; other rarer factors are hematogenous infections, endocrinal glandular disturbance or bone malnutrition. Symptoms are usually mild unless the lesion is large; symptoms of acute inflammation are lacking. The pathology is that of a highly vascular granulation tissue filling the bone cavity, the microscopic picture duplicating in all respects that of granulation tissue.

A pre-operative diagnosis is not possible without the x-ray. In the radiograph the area of osteolysis shows as a

clear-cut rounded or oval spot in the cortex in large lesions this clear-cut appearance is less definite; expansion without breaking of the periosteum is the rule. In the author's experience no hemorrhagic osteomyelitis has penetrated the cartilage separating the epiphysis and diaphysis.

W. W. W.

Further Original Observations with the X-ray Upon the Appendix. Adolph Henriques, M.D., *and* Leon J. Menville, M.D., New Orleans M. & S. J., 74:292, December, 1922.

ATTENTION has previously been drawn to the appendix, apart from the rest of the digestive tract, as a focus of infection, due to retention of food remnants and their decomposition. The appendix may remin filled with opaque meal for days after the rest of the colon has emptied. The authors believe that the appendix fills as the results of anti-peristalsis which is normal in the colon; it empties by peristalsis. If it does not empty in normal time, this is due to defective musculature and is evidence that such an appendix is potentially dangerous, since it may retain bacteria, along with food remnants which act as a culture medium.

W. W. W.

Cysts of the Liver Shown in the Roentgenogram by Pneumoperitoneum and Inflation of the Abdominal Cavity with Nitroxydul. Werner Teschendorf, M.D., Fortschr. a. d. Geb. d. Roentgenstrahlen, 29:567, July, 1922.

FLUID filled cavities in the liver arise in the following conditions:

1. Cysts around foreign bodies, including parasites.

2. Cysts formed through decomposition of solid tissue (tumors, tubercle, gumma, hematoma).

3. Cysts arising from physiological or pathological structures; either retention cysts which usually contain bile colored matter or those arising through wall formation such as proliferative cysts, cystomas, cystadenomas and adenocystomas.

When these cysts are of any considerable size, they can be demonstrated fluoroscopically by the pneumoperitoneum method.

To inflate the peritoneal cavity the author successfully used nitroxydul, a gas which is non-irritative and is quickly absorbed. The absorption of this gas is very gradual and is completed at the end of three hours. Its great solubility, exceeding that of oxygen, eliminates possibility of air embolus. The quantity used for fluoroscopic purposes has never caused any untoward results.

Nitroxydul is obtained by heating ammonium nitrate and distilling the obtained gas through iron sulphate in concentrated sulphuric acid, and again through concentrated potassium hydroxide.

A. M. P.

Diagnosis of Syphilitic Aortitis. W. H. Deaderick, M.D., J. Arkansas M. Soc. 18:109, November, 1922.

IN THE diagnosis of aortitis, the symptoms, physical signs and x-ray examination must be considered.

The symptoms are usually so vague that they do nothing more than suggest an examination of the heart; the most frequent symptoms are pain and dyspnea. Likewise the physical signs are only sufficiently suggestive to indicate x-ray examination, and upon this the final diagnosis must rest. The fluoroscopic and orthodiagraphic examinations will show whether there is a dilatation of the aorta or not. Given the presence of aortitis, although syphilis is more frequently the cause than all other infections combined, it is by no means the only cause. Rheumatic fever takes next place, and as an occasional cause, streptococcic infection must be borne in mind. Typhoid fever and influenza are rare causes; arteriomatous degeneration as a part of a general arteriosclerosis may show the shadows of a dilated aorta on the fluoroscopic screen.

W. W. W.

Treatment of Skin Cancer by X-rays, Radium and Electrocoagulation. G. E. Pfahler, M.D., New York M. J. and M. Rec., 116:553, November 15, 1922.

PRACTICALLY all cancers of the skin can be successfully treated by means of x-rays, radium and electrocoagulation, provided they are treated early and skilfully.

Precancerous dermatoses are best treated by electrocoagulation, using a fine brush spark from the Oudin current; they may also be treated by x-rays. Warts and moles are best removed by electrocoagulation using more current; they will also respond to x-rays and radium. Basal cell epitheliomas respond readily to any form of treatment which destroys the cancer cells; the preferable method is a destruction by the Oudin current followed by a full erythema dose of x-rays. Where a scar is objectionable, the x-rays and radium are preferable, either agent being effective. Squamous cell epitheliomata are more difficult to cure and thorough treatment is essential. Three or four erythema doses should be used at once, or the dose kept at the point of saturation until the lesion disappears. Adjacent glandular areas should be thoroughly treated. Incomplete treatment is worse than no treatment. In epitheliomata with metastases, the author's preference is the burying of radium in the metastases, rather than surgical removal. In many cases, two or more methods can be combined to good advantage.

W. W. W.

Value of X-ray in Skin Diseases. M. V. Leof, M.D., New York M. J. and M. Rec., 116:377, October 4, 1922.

THE X-RAY is the most potent factor in the treatment of skin diseases and by far the most valuable single agent we have. It is useful in nearly every disease of the skin; in some it will only alleviate symptoms; others will abate temporarily after treatment, and still others will be cured permanently.

In acne vulgaris the x-ray is superior to all lotions, salves and vaccines; ten to sixteen fractional doses will usually effect a cure.

In sycosis vulgaris the results are not constant; on account of excellent results in some cases, all cases should be tried.

In furunculosis the x-ray is of great value in treatment of recurrent lesions.

In tinea tonsurans depilation of the scalp will cure all cases, and this may be accomplished in one sitting.

In favus the same results may be accomplished.

Eczema usually embraces a variety of skin conditions, and definite statements cannot be made in a general way. The x-ray, along with other methods, will usually be of benefit.

Psoriasis responds readily to radiation, but recurrences are common.

In regional pruritis, unless caused by diabetes, x-ray is of distinct value.

Tuberculosis of the skin and allied conditions are not favorably influenced. (Abstractor's note: This is contrary to the experience of many radiologists).

Warts respond readily to x-rays, multiple warts being removed without scars or pain.

Senile keratoses will be removed by one or two exposures.

Nevi are not, as a rule, satisfactorily treated by rays.

Young and small keloids invariably disappear under the rays, and will not recur.

Rhinoscleroma is curable by x-rays as is dermatitis papillaris and acne keloid.

Radiotherapy is the method of choice in the treatment of most skin malignancies.

W. W. W.

Quartz Lamp Therapy. A. J. Pacini, M.D. Reprint abstracted by author.

A CLINICAL catalog of various conditions in which quartz lamp therapy (ultraviolet radiation from air-cooled and water cooled equipment) is useful is presented.

The information is culled from an experience gained by observing competent users of equipment at work in their offices, dispensaries and hospitals; by maintaining an intimate correspondence with distinguished clinicians who are utilizing ultraviolet energy with obvious success; by studying the literature that has appeared in Italy, France, England, Denmark and Germany; by studying American literature.

The first section is devoted to an enumeration of skin conditions and includes acne, baldness, chancre (soft), epithelioma, erysipelas, furunculosis, gangrene, lupus, nevus, scars and ulcers.

Not all of these conditions are bettered; the author points out the various pitfalls and the indications for choosing energies other than ultraviolet.

The next question is devoted to the study of anemia, cachexias, chlorosis and fevers. It presents a principle of "fixation" of metabolites which gives a useful concept in determining the course that should be used when ultraviolet energy is employed as an adjuvant in the treatment of these various conditions.

Then there is a section devoted to certain digestive disorders, wherein mention is made of auto-intoxication, cirrhosis of the liver, constipation, gastric ulcers, gastritis and hyperacidity.

Certain nervous disorders are commented upon, including hysteria, locomotor ataxia, melancholia, myelitis, neuralgia, neuritis.

The sixth section discusses gynecologic entities with reference particularly to amenorrhea, dysmenorrhea, metritis, ovaritis.

"This brief enumeration of conditions is only a partial list of indications calling for ultraviolet energy. Of course, our knowledge for the use of the energy in these conditions is in many cases empiric, but empiricism resulting from the close observation of prominent clinicians can not be considered as beneath the level of the scientific worker. We may conclude by saying that the solution of the mechanisms whereby ultraviolet effects a clinical remedy in the diseases mentioned offers an unusual opportunity for research investigation that must inevitably lead to a more advanced and clinically brilliant therapeusis."

A. J. P.

Early Diagnosis of Cancer of the Stomach. Jonathan Forman, M.D., Ohio State M. J., 18:764, November, 1922.

EVERY satisfactory gastro-intestinal diagnosis rests, as someone has said, like a stool, upon four legs, viz., (1) history; (2) physical examination; (3) x-ray study, and (4) laboratory findings. Neglect of any one of these invites failure.

In the history, failing appetite, acid eructations and pain are the usual symptoms. However, pain may be absent and the appetite good. In the physical findings, loss of weight and loss of strength are the most important.

The x-ray findings are more or less characteristic, though some cancers are difficult of detection. The examination should be thorough, both by fluoroscope and by radiographs in various positions. The direct visualization of the filling defect is the only positive sign of cancer. The indirect evidences (Carman) need to be interpreted along with the other findings.

The laboratory examinations have unjustly been pushed into the background by the emphasis laid on the x-ray examination. Examination of the fasting contents gives the best evidences of cancer.

When the clinical history, the physical findings, the x-ray study and the laboratory data are combined, they will form a net through which few cancers of the stomach can escape.

W. W. W.

Experimental Duodenal Stenosis and Atony of the Stomach. Walter Konnecke, M.D., Zentralbl. f. Chir. 49:1617, November 4, 1922.

THE AUTHOR produced artificial duodenal stenosis and kinking in five dogs by narrowing the duodenum with a strip of fascia and attaching it to the costal arch. The operation was well borne by all of them. At first only liquid food was given, later, solid food, and after a short time the dogs appeared to be normal in appetite, in bowel movements, etc. Roentgenological observations showed a highly increased peristalsis, good tonus of the stomach and duodenum. On section there was marked hypertrophy of the stomach and duodenum. The conclusion is that the healthy stomach and duodenum react to stenosis and kinking by hypertrophy and hypermotility.

In a second series the author produced artificial atony by double subdiaphragmatic vagotomy. Roentgenological evidence showed constant atony and ectasia of the stomach. No resemblance to the human form of gastric atony was found.

Entirely different results followed when a combination of the two was applied. Of the four dogs with combined artificial stenosis and double vagotomy, three died of the operation in about one week. The fourth dog, however, succeeded in overcoming the critical period and recovered.

Section showed the stomach musculature flabby. There was marked enlargement, the stomach occupying half of the abdominal cavity, the duodenum also was somewhat dilated. While the author hesitates to apply his experimental observations to human pathological conditions without further study, yet he finds here some resemblance to the clinical picture of acute duodenal stenosis with disturbance of innervation. The fact that with normal innervation the stomach reacted well to the acute stenosis shows that the pathological picture of the acute duodenal stenosis is not purely mechanical; that the dilatation of the stomach is not secondary to the stenosis of the duodenum, but that the stomach condition is primary, due to disturbances in innervation, and the stenosis of the duodenum is secondary. The weakened vagus action results in an increased sympathetic activity. The increased sympathetic activity may also come from injury to the vagus by toxins in acute infections, or by operative injuries to the plexus of the stomach wall in various abdominal operations, or even by some endocrine disturbance.

A. M. P.

Ray Treatment of Cancer. J. Thompson Stevens, M.D., New York M. J. & M. Rec., 116:386, October 4, 1922.

THERE is no question about the operative removal of any malignancy which can be removed entirely. When metastases cannot be removed entirely, cases should not be operated, or if operated, should receive preoperative and postoperative radiation.

When radium is to be used, x-rays should precede, being directed to the lymphatics and borders of the disease.

Radium is the ideal agent for use within the growth itself, within metastases and for recurrences, the preferable time being between the x-ray exposures.

Recent advances in radiation therapy have given a more definite technique and better results are to be expected.

W. W. W.

Physical Basis of Deep Roentgen Therapy. Frank Rieber, California State J. Med., 20:350, October, 1922.

IN CONSIDERING deep roentgen therapy from the physical standpoint,

only one biological factor needs consideration, the balance of the problem being physical or engineering. That biological factor is stated thus: (1) Any living tissue, if exposed to a small quantity of roentgen radiation, is stimulated to a condition of greater activity.*

(2) If the amount of roentgen rays delivered to this tissue is increased, the activity of the tissue is not stimulated further, but on the contrary, is inhibited and if the radiation is further increased the tissue is destroyed.

The biological problem then is to deliver the largest permissible quantity of rays into a tumor without exceeding the safe limit of radiation in any other part of the body.

The author then discusses the physical principles of rays of low penetration and of high penetration (short wave lengths), and the variations in depth absorption, together with the importance of scattered radiation in using high voltages. The engineering problems involved in constructing apparatus to deliver high voltages are not difficult, although the tubes at present available have their limit of safety around 220,000 volts.

*Abstractor's note: This is not a generally accepted biological law, many radiologists contending that x-rays are destructive in any dose and are never stimulative.

W. W. W.

Roentgenology in Its Relation to the General Practitioner. W. M. Phelps, M.D., Virginia M. Monthly, 48: 444, November, 1922.

ROENTGENOLOGY is one of the most highly specialized branches of medical practice. The relation of the roentgenologist to the physician and surgeon is that of a consultant solely, thereby differing from other specialties. The value of the roentgenologic examination depends entirely on the ability of the roentgenologist to interpret the shadows in terms of pathology. In many instances the roentgenologist must study the case as a whole and in connection with other methods of examination before an intelligent opinion can be rendered. Several illustrative examples, in connection with lesions of different organs or regions of the body are given.

W. W. W.

Cancer of the Larynx Treated by Radium. Douglas Quick, M.B., *and* F. M. Johnson, M.B., New York State J. Med., 22:462, October, 1922.

IN APPLYING radium to laryngeal growths, certain difficulties arise which are not met with in other parts. If applied efficiently, radium produces a sharp inflammatory reaction which interferes with swallowing and breathing, so that a definite estimation of what is to be hoped for must be made, and treatment given accordingly. A great advance in treatment has been secured through the practice of introducing emanation tubes directly into the growth. Detailed description of dosage and filtration is not given. Statistics of the cases treated during the past five years are given and cover 156 cases. The conclusions are as follows:

While radium offers a hope to a larger number of cases of cancer of the larynx than older methods, its use is still experimental.

Before treatment is started, an estimation of what can be hoped for should be made and treatment given accordingly.

In primary operable intrinsic cancer, radium treatment may be permissible, but the evidence to date has not established it as the method of choice.

Pre-operative treatment may materially improve the end result.

Surgical exposure may be required for proper radium localization.

Radical use of intensive radiation is permissible in cases offering a reasonable hope of complete recovery.

In inoperable cases, the conservative use for palliative relief is advocated.

In very advanced cases, radium should be withheld.

W. W. W.

Diagnosis and X-ray Treatment of Toxic Goiter, with Report of Five Cases. W. E. Killinger, M.D., Virginia M. Monthly, 48:469, November, 1922.

GREAT care must be exercised in the diagnosis of thyroid enlargement, as a certain amount of enlargement is sometimes physiological; some of the later laboratory methods, in addition to a careful history and analysis of the sysptoms, will be of value.

The employment of x-ray in treating goiter dates back to 1898, and many articles reporting favorable results are to be found in the literature. Five cases are reported where these results were obtained. These cases were of the hyperplastic type; careful physical examinations were made with metabolic readings in the beginning, again after three treatments, and, finally, after the symptoms had disappeared.

The technique used was a one inch spark, 6 mm. aluminum filter with one thickness of sole leather, 8 inch skin distance, 6 ma. of current for 12 minutes over each area, treating three areas, one over each lateral lobe and one over the thymus. Dose repeated in three weeks.

W. W. W.

X-ray Treatment of Tonsils and Adenoids: A Preliminary Report. Sidney Israel, M.D., Texas State J. M., 18:301, October, 1922.

THE author has attempted to prove to his own satisfaction whether the claims of Witherbee are justified and whether radiotherapy of tonsils and adenoids should have a prominent place in the treatment of these structures. The cases selected for x-ray and radium treatment have been those deemed inoperable because of various reasons. As the result of his work, the author found that x-ray or radium would produce a definite atrophy or shrinkage of the tonsil and adenoid tissue. In many cases in which one could express quantities of cheesy material from the crypts before treatment, this was no longer possible, after the atrophy occurred. Further the local symptoms disappeared. He compares the two methods of treatment as follows:

Operation: Hospital expense, anesthetic with possible pneumonia or lung abscess, contraindications frequent, hemorrhage, pain, loss of weight, loss of time, no tonsils, deformity from scar tissue or injury, time consumed about ten days.

Radiotherapy: No hospital expense, no anesthetic or anesthetic dangers, no operation, no hemorrhage, no pain, no loss of weight, no loss of time, tonsils atrophied, but still present, no deformity or injury, time consumed six to ten weeks.

The author feels that radiotherapy will not replace a well and carefully performed operation, there is a strong likelihood that a definite place will be established for radiotherapy in laryngology, as a therapeutic measure applicable to a certain number of cases.

W. W. W.

Chronic Non-Tuberculous Lung Diseases. W. Warner Watkins, M.D., Texas State J. Med., 17:396, December, 1922.

NON-TUBERCULOUS chest diseases are too frequently diagnosed as tuberculosis, without sufficiently careful consideration of the other possibilities. The non-tuberculous chest conditions which are mistaken for tuberculosis may be divided, for convenience in study, into three classes.

1. Conditions which are not essentially lung diseases, such as cardiorenal syndrome, aortitis and aneurism.

2. Non-infective conditions, such as tumors, pneumoconiosis and foreign bodies.

3. Infections, the three most important classes being syphilitic, mycotic and post-influenzal, including metastatic.

These various conditions and their differentiation from tuberculosis are discussed. W. W. W.

X-rays in the Diagnosis of Pulmonary Tuberculosis. John D. MacRae, M.D., Southern M. J., 15:870, November, 1922.

1. Stereoscopic lung plates are most valuable, and all other methods of x-ray examination are secondary in value.

2. Interpretation of x-ray of the lungs should be made independently of the clinical findings in the case.

3. The radiologist and clinician should hold a conference on each case examined and compare notes on their separate findings.

4. Terminology and technique should be standardized.

5. Studies should be made of the normal chest in order to interpret plates of the pathological.

6. Postmortem examination of tuberculous patients should be made as often as possible, for the purpose of correlating densities in the x-ray plates with actual lesions in the lungs.

W. W. W.

A Study of the Clinical and Radiological Findings in Pleurisy. Drs. M. B. and P. F. Titterington, J. Missouri M. A., 19:465, November, 1922.

THE USE of the x-ray in pleurisy is only one method, but is a great aid in helping the clinician to arrive at exact conditions.

In dry pleurisy, there is obscurity at the base of the lung, the diaphragm is hazy and deformed and loses its mobility; the costo-phrenic angle may be partly or wholly effaced.

In pleurisy with effusion, the x-ray aids not so much in the initial diagnosis as in following the progress of the case, noting from time to time whether the fluid increases or decreases.

In the dry interlobar pleurisy, the x-ray is about the only means of diagnosis and great care must be exercised in the examination, otherwise this method will fail. The signs are more evident when interlobar effusion occurs.

W. W. W.

Diaphragmatic Hernia — Non-Traumatic, with Report of Four Original Cases. E. H. Kessler, M.D., J. Missouri M. A., 19:461, November, 1922.

TRAUMATIC cases are not rare, but congenital cases are quite infrequent. It is not always possible to exclude trauma. The four cases reported, with radiographs, had no history of trauma, two of them dating back into childhood, the other two dating back some years. All were in adults. X-ray examination will usually make plain the condition, although the clinical history is usually misleading, and the viscera may pass in and out of the thoracic cavity. W. W. W.

Radium in the Treatment of Myelogenous Leukemia. A. Henriques, M.D., *and* Leon J. Menville, M.D., New Orleans M. & S. J., 74:247, November, 1922.

THE technique of application, for which the authors claim originality, consists in the application of radium externally over the area of splenic enlargement. The dosage consists of 2,200 to 2,400 milligram hours spread over four areas near the center of the spleen, repeated monthly; this means that each area receives 550 to 600 milligram hours, the areas being one inch square, the radium elevated ¾ inch from the skin surface and filtered through 2 mm. of lead.

W. W. W.

Roentgen Ray Treatment of Adenopathies. Mulford K. Fisher, M.D., New York M. J. & M. Rec., 116: 389, October 4, 1922.

LYMPHATIC disease is usually a secondary phenomena and the indications for x-ray treatment are applicable only to selected cases. A careful search and exploration for the underlying pathology must be made and first effort directed toward its elimination. The conditions which respond to x-ray are quoted from Knox, as follows: Inflammatory enlarged glands, lymphadenomatous glands, sarcomatous glands, tuberculous glands, carcinomatous glands, mixed infections. The author adds the lymphoid tissue of the tonsils and adenoids.

The inflammatory type of enlarged glands rapidly responds to x-ray treatment, and surgery has practically been abandoned in this type of case, especially in the cervical adenitis of children. The tuberculous type responds more slowly and recurrences are frequent; the thymic enlargements come under this same head and yield readily to radiation.

The lymphadenomatous glands, including Hodgkin's, rapidly recede, but practically always tend to reappear.

The carcinomatous glands respond slowly, and the effect of radiation is variable.

The tonsillar and adenoid tissues shrink and atrophy under radiation, and this method of treating disease of these structures has opened a wide field.

W. W. W.

Cancer of the Breast: Combined Treatment by Surgery, Radium and X-ray. John T. Moore, M.D., Texas State J. Med., 17:352, November, 1922.

RODMAN, in 1908, said that "there is but one treatment for cancer of the breast—operation—the earlier the better." Surgical technique having about reached its limit, surgeons have begun to look to other remedies as adjuncts, and today, surgery, radium and x-ray represent the sum total of all the methods we possess in combating cancer. For inoperable cases, radium and x-ray offer the only palliative treatment.

For the operable cases, the following is considered the best present method: The first and most important requisite is the service of a thoroughly trained and optimistic roentgenologist. The body from the navel up to the neck and including the axillae is blocked off into ports of entry and a full dose given to each of them, beginning with the peripheral, the glands and tumor being rayed last. Since it requires from three to four weeks for sufficient fibrosis to block lymph vessels, operation should not be done for at least three or four weeks, probably not later than six weeks. After this time, a radical and clean dissection should be done, removing breast, glands and gland-bearing fascia. Muscles are not removed, preoperative and postoperative raying is depended upon for these. After the operation is controlled and bleeding stopped, radium properly screened is placed in the axilla, so arranged that it may be drawn down and expose the subscapularis, latissimus dorsi and serratus muscles; where there is sufficient radium, the supraclavicular and infraclavicular regions should be rayed, with especial attention along the outer border of the sternum and the region about the lower end of the sternum. The radium may be left in position from six to ten hours, then drawn into a new position. After a period of ten days to two weeks, the body is again blocked off into areas, and again thoroughly rayed, with especial attention to the areas where metastases are likely to occur—the mediastinum, axilla, clavicular regions, epigastrium, inner and lower part of the opposite breast and the intercostal areas over front and back. Additional treatments should be given in from six to eight weeks following the last radiation. Watch for recurrences and treat these as soon as they are seen.

Some patients will die in spite of all you can do, many will surprise you by living longer than you thought they could, and a few of the severe cases will get well. W. W. W.

Treatment of Uterine Cancer. Rex Duncan, M.D., Texas State J. Med., 17:366, November, 1922.

THE RESULTS of surgical treatment are graphically shown by the figures of Janeway, who tabulated the results of 6,000 cases reported by surgeons of this country and Europe. These results show that, for every 100 patients presenting themselves for surgical treatment, 60 must be turned away without treatment; of the 40 who are operated on, 18 per cent, or 7 patients, die as the result of the operation; 8 patients will be cured and the remaining 25 will have a recurrence. The 60 who are turned away, the 7 who die from the operation and the 25 who have recurrences, leave only 8 per cent who are cured, and 92 out of each 100 patients are doomed unless some other method than surgery comes to their relief.

The rapid progress in radium therapy in uterine cancer, and the more recent addition of high voltage x-ray therapy offer good reasons for believing that this mortality can be lessened. The present procedure is somewhat as follows: During a hospital period of from five to seven days, the patient is given a total of 6,000 to 10,000 millicurie hours. After the local reaction has subsided, in from six to eight weeks, she is given a thorough radiation with high voltage x-rays.

In a total of 300 patients treated, more than two years ago, there are 122, or 40 per cent, who are clinically well for periods ranging from two to seven years. Of these there were 272 cases who were inoperable, and of these, 99, or 36.4 per cent are clinically well.

W. W. W.

The New Roentgenotherapy in Gynecology. James T. Case, M.D., Texas State J. Med., 17:360, November, 1922.

THE essentials of the "new roentgenotherapy" which is attracting so much attention at the present time are (1) long target-skin distance, (2) high voltages of 200,000 volts or higher, (3) high filtration of from 0.5 to 1 mm. of copper, (4) large areas of treatment, or ports of entry. The object of all these essentials is to deliver a greater percentage of x-rays into the deeper tissues and a minimum of rays which are absorbed by the skin. Any lesions which are accessible can be attacked more rationally by a combination of radium and xx-ray.

When the massive dose is to be given as nearly as possible at one seance, the patient requires the same preparation as for a major surgical operation. The object of the attack is to deliver to the area under treatment approximately 120 per cent of the skin erythema dose for carcinoma and 70 per cent for sarcoma, this dose to be evenly distributed to all the pathological tissues at one sitting. In practice the dose is seldom given at one sitting, but is distributed over two or three days with an added day for the radium application. Under the working conditions of the author, 800 mam., at 200 kv., with 1 mm. of copper filter, 50 cm. skin-target distance, produces a mild erythema on the skin of the neck; immediately after the treatment there is a reddening of the skin, followed in about three weeks by a definite light brown discoloration which later becomes more marked. For uterine carcinoma, four areas are treated, the anterior and posterior fields being 16 to 20 centimeters square, lateral areas smaller. The author follows the Freiburg school in administering the dose as quickly as possible, through as large ports as possible, although he describes the Erlangen technique from which just as favorable reports have come. By this latter technique the pelvis is divided into three zones; the first aimed at the uterus is treated through six or seven small portals; after six weeks the right pelvis is treated through six small portals, and after an additional six or eight weeks, the left pelvis in a smaller manner. The author has not noticed any significant changes in blood findings, a fall of four or five per cent in red cells being the maximum change noticed. Rectal and bladder tenesmus are fairly frequent sequels. Roentgen sickness is a frequent and very disturbing sequence.

The immediate results since this treatment was started in January, 1921, have been very encouraging, and the outlook for permanent results is bright.

W. W. W.

Radium in the Treatment of Menorrhagia and Metrorrhagia, with Case Reports of Forty Successful Cases. E. T. Newell, M.D., J. Tennessee M. A., 14:266, October, 1922.

THIS STUDY includes only the cases of hemorrhage due to hyperplastic endometritis of long standing. The treatment in such cases is so effective that other methods need not be considered. The discussion does not include cases of hemorrhage due to fibroid tumors, polyps, malignancies, infections, etc. Patients are divided into two groups, those at or near the menopause and younger patients (20 to 35), the treatment differing materially in technique. In young women under 35, the radium is introduced directly into the cervical canal and uterus without preliminary dilatation and without previous curettage. Fifty milligrams are inserted and left four to eight hours. Treatment is repeated only if the following menstrual flow is excessive, the dosage being less at the second application. In cases at or near the menopause, dilatation and curettage should be done on account of a possible malignancy, the radium being applied at the time of curettage, and the time of application lengthened in order to establish the menopause more promptly. If the scrapings are found to be malignant, radium in appropriate doses or surgical procedures, as indicated, should be followed. Several case reports are given. W. W. W.

Radium Therapy of Benign Uterine Hemorrhage. H. Kupferberg, M.D., Fortschr. a. d. Geb. d. Roentgenstrahlen, 29, June, 1922.

THE AUTHOR has used radium element for intra-uterine applications since 1914. Four hundred and fifty cases were irradiated, of which 338 were myomata, and 122 were metropathies.

Technique: After careful disinfection the cervix is dilated, and 50 mgms. of radium element filtered with 1.5 mm. brass, 1.0 mm. silver, or 0.8 mm. gold introduced into cavity. Sometimes introduction into the cervix or even into the vagina is sufficient.

Dosage: To produce permanent amenorrhea 1,800 to 2,000 mgm. hours are required. Less duration gives only temporary amenorrhea.

Results: In 43 young women there was marked shrinkage of the myomata, with menstruation after one year. Six of them gave birth to healthy children subsequently.

Indication: Menorrhagia, metrohagia, juvenile and climacteric menstruation, myomata below the level of the navel, stubborn cervical catarrh, osteomalacia, inflammatory tumors of the adnexa, and for artificial sterilization.

Contraindications: Myomata having undergone softening, and submucous myomata. Where malignancy is suspected 4,800 mgm. hours should be given. In cases of inflammatory tumors of the adnexa the application must always be intravaginal.

Action of the rays: The action of radiation is not directly on the ovarian tissue, but secondarily through the endometrium and myometrium.

Sequelae: There often occurs a bloody discharge. Atrophy of the myomata is accompanied in 60 per cent of cases with atrophy of the follicular apparatus and of the endometrium. There is no atresia, there is no disturbance of the libido, and no shrinkage of the vagina. False passage avoided by careful technique.

A. M. P.

Radium in Gynecology. O. L. Norsworthy, M.D., Texas State J. Med., 17:370, November, 1922.

THE conclusions of this author as to the use of radium in gynecologic conditions are as follows:

(1) Radium is probably the greatest discovery of interest in the treatment of gynecological conditions since Simpson discovered the general anesthetic in 1847.

(2) Radium is the safest, surest and most adaptable remedy in hemorrhage at the menopause, especially when associated with a chain of neurotic symptoms.

(3) In soft, rapidly growing uncomplicated myomas, if not larger than a four months pregnancy, in women over 40 years of age, radium is uniformly effective and is the safest remedy known.

(4) Radium has no equal as a palliative in inoperable cancer of the uterus.

(5) In the light of what has already been accomplished with radium, I am encouraged by the hope that with more knowledge of the properties, its rays and improved technique of application, cancer may eventually meet its master.

(6) Less than 125 mgm. of radium will not permit of sufficient range in dosage to promise the graded dosage used in non-malignant conditions, in addition to the heavy doses necessary in treating cancer.

W. W. W.

Value of Transuterine and Transabdominal Gas Inflation of the Female Pelvis with Carbon Dioxide. Roland S. Cron, M.D., Wisconsin M. J., 21, November, 1922.

SINCE the work of Peterson and Van Zwaluwenburg in this method of pneumoperitoneum, the procedure has become so popular in the University of Michigan hospital that it has become necessary to establish an inflation clinic, and any case whose diagnosis is in doubt after the usual history and examination is referred to this clinic for further study. The practice in this clinic is to have the roentgenologist's opinion given entirely aside from any knowledge of the history or previous examination. The apparatus and instruments used have been previously described. Transuterine inflation is the method routinely used, and carbon dioxide is the gas employed. This is the best and most reliable method of establishing the patency of the fallopian tubes. Further, for the examination of the pelvic organs, this method is of great value. A chronic salpingitis or salpingo-ovaritis, and pelvic adhesions are easily recognized. Pregnancy as early as the fifth or sixth week has been diagnosed. Fibroids of the uterus and ovarian cysts are recognized without difficulty.

W. W. W.

Treatment of Carcinoma of the Uterine Cervix. Stanley A. Clark, M.D., J. Indiana M. A., 15:339, October, 1922.

THE surgical extirpation of carcinoma of the cervix has been extensively and more or less radically employed for the past forty years, but the literature of the past year contains few opinions favorable to the continuance of these radical operations. A notable exception is Cobb, who claims 57 per cent of cures in sixty cases of hysterectomy for moderately advanced carcinoma of the cervix. Could such a percentage be maintained by other surgeons, there would be no reason for seeking other methods, but a distinct pessimism pervades the writings of our greatest surgeons, and during the past five years, more and more attention has been given radiation therapy. Many surgeons use radium as an adjunct to surgery, but the author believes there is no such middle ground and that the cases are either surgical entirely or should be treated solely by radiation. If pre-operative radiation is used, this should be by x-ray to the maximum dose of deep radiation, followed by radium in the vaginal vault and a second course of x-ray. His personal observation is that the combined use of radium within the cervix and uterus and deep roentgenization from without offers the best hope to the average patient presenting herself to the surgeon for treatment of cancer of the cervix. The results of this method are not ideal, but they are the best that offers today.

W. W. W.

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The Progression of the Chest and the Determination of the Normal---A Preliminary Report*

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MR. CHAIRMAN, it is again my privilege to address this society upon a subject which forms a no small part of our specialty as radiologists. And likewise, the diseases of the chest form a no small part of the diseases of the body as a whole. The success in treatment of many of these same diseases depends upon early recognition by the x-ray. With this in mind I beg your permission to restate certain facts, that they may receive what would seem to be proper emphasis, and recount certain others from the most excellent history of radiography. In addition I wish to propose still another method for the study of the chest—a method that to me would seem to offer some promise of a greater understanding of our problems.

In looking through pictures taken even as early as 1897, it is rather disconcerting to see what excellent reproductions were obtained. It is true that these were the unusual, whereas today the results are more uniform. But it does seem that the average of the present time should be much above the exception in the early days of radiography. This may be explained by the wide range of the present day radiograph and the varied and new fields into which the radiologist has had to enter. We have hardly had time to work out all the problems peculiar to any one part of the body.

In making a recent survey of the literature it would seem that the first radiagraph of the thorax was probably made in 1896 by Doctor Arthur W. Goodspeed, with an exposure of forty-five minutes, showing at least good bony detail. A few months later this exposure was reduced to one minute by his assistant. Developments in technique were very rapid and in 1900 Doctor Francis H. Williams reported very excellent pictures of the chest taken in two to four minutes. The fluorescent screen was used at a correspondingly early date and Williams is given credit for showing an ingenious fluoroscope, before the Association of American Physicians on April 30, 1896.[1]

It soon became evident to these early workers that the radiograph of the chest must be taken with a very short exposure, so that Rieder and Rosenthal in 1905 reported before the Roentgen Congress in Berlin, skiagrams of the thorax taken in one-tenth of a second. The reproductions made from these originals are really very excellent. It is interesting to note that in 1911 Rieder was taking his chest pictures in one to two seconds, while in 1910 Dessauer reported a new method for taking the same pictures in one-fiftieth to one one-hundredth of a second. It would seem that these very short exposures were taken by special apparatus in laboratory experimentation and were not carried out to any extent in actual practice. Doctor A. Howard Pirie, in making a survey of the German laboratories in 1911, reported that these same workers were making their chest radiographs in two to three seconds. Robert Knox in his text of 1917 states very emphatically that a chest radiograph made in greater than one-tenth of a second has very little diagnostic value, but we are unable to get further reports on his work. Of the Americans, Doctors Dunham, Orndoff, Caldwell, Cattell, Pfahler, Hirsh and Alden Williams have done considerable in developing the chest technique, and I know that many others have never published results of many long hours spent in this experimental work. In 1908 Rieder and Rosenthal reported chest radiographs made upon a special film by means of double intensifying screens, but later discontinued the use of screens. Doctor Mackenzie Davidson reports the use of stereoscopy in the interpretation of x-ray photographs as early as 1898.[2]

This survey tends to prove that a definite need for short exposures does exist, and has been felt by the careful workers. And it is my opinion that the present generation realizes the importance of this factor. But the average radiologist considers this procedure as being either too difficult, too expensive, inconvenient, or not practical for routine. It is for this reason that I wish to speak rather frankly of my own experience.

After a review of considerable material, I began in 1916 to realize that cases were sent to my office not to learn whether any infection existed, but rather how much gross pathology was present. Feeling rather humbled by this realization, and without the information of what other workers had done, I set about to solve this difficulty, and from fluoroscopic and radiographic observations, noticed that chest radiography had certain natural advantages as well as disadvantages. Of the former, I might mention that we are dealing with air, fluids and solids, each of which has its own resistance to passage of the roentgen ray and therefore affords a great deal of contrast. The pleura and the connective tissue septa around the smallest lobules quickly thicken under the slightest irritation and offer resistance to the ray, while the lymphatic drainage along the bronchi undergoes similar changes. The outstanding disadvantage is the movement of the intrathoracic viscera. Also, the chest is barrel-shaped, giving overlapping of structures and is held away from the plate by the muscles of the back, and the breast in front.

After a year's trial with short exposure and double intensifying screens I endeavored to set forth before this society, in 1918, certain views which I obtained from this work. Later, in a series of articles, I described the advancement and the various phases of chest radiography as I encountered it.

Today, after five years' experience in all classes of work, I feel free to state that this method is practical, and not a mere novelty in laboratory pro-

*—This work is being made possible through the aid of the Selmene Winter Foundation. Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 7, 1922.

cedure. Neither is it more inconvenient, certainly not difficult, and only slightly more expensive.

To me it has meant that cases are now sent not for survey as to gross pathology but for a minute study of the lungs. Certainly we have not overcome all the disadvantages, and much is left to be done in the future. I know that others in this country have taken up this work and that their conclusions are similar to mine, but the percentage in comparison to the number of radiologists is woefully small.

The advantages of the present day apparatus, if properly utilized, would be a tremendous, if not a deciding factor in the fight against tuberculosis and other diseases of the chest.

After the development of a technique which we know from clinical and pathological observations shows very minute changes from the normal anatomy into the pathological, there comes a crying need for a greater knowledge of these processes. As we turn to equip ourselves with this information we are rather at a loss as to how to get it. There have been two main methods of study, the pathological at the postmortem table, and the clinical. The literature has been reasonably full of information gained from these methods, by the investigations of numerous workers, but Doctor Dunham has done the most by his consistent and continuous efforts, to bring us to definite conclusions. Ghon's book was enlightening and from the clinical standpoint we have had observations from numerous sources. There has been a third method used to a lesser extent—namely, the x-raying of a group of cases selected at random. All three are very important for our final analysis and yet inconclusive. After such studies we still feel unfamiliar with the minute processes that occur in the chest.

The radiograph is the portrayal, upon an emulsion, of the normal anatomy and its physiological and pathological variations. It does not seem proper that our study of any individual film should begin with the pathological, but rather should begin, as does a pathologist in studying a section, with the normal anatomy and follow its changes over into the pathological as shown upon that particular film. Life is a series of actions and reactions, and there is no place where this history is registered to better advantage than in the lung structures. These actions and their re-actions do not begin at six, twelve, or fifteen years of age, but at birth. The marks of these struggles must be taken into our consideration along with the normal evolution and development. The home environment, occupation, residence and habits as well as infection and injuries are factors as to what a given chest will show up on a radiograph and begin their influence early in life. Also in the process of development there is a normal tendency toward a fibrous change. All these influences and tendencies, together with the usual infectious diseases, when considered as a whole are quite normal, if the reaction balances the action, and for this we have chosen the term *progression*. It is a progress quite definite in character but with no definite termination. What is normal for one child may not be normal for another, and it does not seem proper if we have a bronchus in a certain place or a hilus of a certain width that we should call these normal or pathological, but rather that we endeavor to study the character of any individual shadow. It would then seem that further data as to this progression might be of some help. With this in mind we began, one year ago, the study of children from the time of birth. Each child is radiographed within the first two weeks after birth and then radiographed successively at frequent and stated intervals, with close study as to the clinical findings, the family history, home environments, and any factor that may be of any influence on the child's life. Radiographs are taken after illnesses, such as the usual childhood infections. These children are coming from all classes of society in our city so that we must also make group studies at various ages from children on the streets. And as the chest diseases of our city tend toward tuberculosis, certain pathological postmortem observations are also accessible. The serial study of chests is coming into greater favor and certain men now recommend it as very important in the making of definite diagnoses. The technique will be that necessary to overcome the difficulties previously described.

With your permission, I hope at a future meeting to give you my data as it is made, that I may have your discussion and conclusions.

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Surgical Diathermy in Its Relation to Radiotherapy*

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SURGICAL diathermy comprises the application of destructive heat to animal tissues and structures, which heat is produced by high frequency currents. It is not a direct application of electricity; by virtue of the numerous reversals of the electric current all physiologic actions as electrolysis or the excitation of excitable tissues are eliminated. The heat is either produced by the spark due to the closing and interrupting of the current or by the resistance that the animal tissues offer to the current forced through them.

The modern diathermy apparatus are constructed in such a way that, though of low voltage (2,000 to 2,500) an amperage of up to 5,000 milliamperes may be reached. This simplifies matters considerably. While all the necessary destructive heat may be developed, complex insulation of the patient and operator and the use of specially constructed nonconducting retractors become unnecessary—precautions that had to be minutely lived up to with the old fashioned apparatus of high voltage.

Destructive heat always has had a recognized place in the surgical armamentarium especially in dealing with malignant growths, that for some reason were not deemed fit subjects for the knife.

The advantage of surgical diathermy in this field of operative endeavor is two-fold, technical and clinical. Its superiority over the Paquelin, the soldering iron and the galvanocautery is based upon essential items.

Surgical diathermy guarantees an orderly procedure of coagulation without any incidental interruption, which is so frequently observed during the use of the appliances mentioned above, and which is caused by the cooling off of the instrument or by the resistance of the scab formed by the burning. The increased resistance of the scab and the subsequent non-accessibility of the deeper structures is overcome in diathermy by increasing the current, and above all, the extension of the coagulating effect as to surface extension and penetration may be gauged accurately

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and is entirely within the control of the operator.

There is no technical limitation for the extent of coagulation produced by the high frequency current and the same holds good in respect to the anatomic qualities of the tumor to be destroyed, while the limits of the successful employment of the actual cautery are pretty soon reached if one has to deal with a large, spongy, well vascularized growth. Another consideration will also militate in favor of surgical diathermy.

The destruction of a pathologic structure by the actual cautery, if of any considerable extent, implies the same danger as an extensive burn of a normal tissue. Extensive burns are apt to lead to a flooding of the system with the products of burning which either produce severe general symptoms or in certain instances cause the development of dangerous, occasionally fatal, ulcers of the intestinal tract. This danger is eliminated by the application of electrocoagulation since the lymphatics around the coagulated area are immediately and thoroughly sealed, and any secondary absorption is thus prevented.

The indications for surgical diathermy expanded with the development of the technique and the immediate results improved. Soon, however, the fact became apparent that the paramount issue in electrocoagulation of malignant tumors lies in its conjugation with radiotherapy.

For quite a while it was an accepted thesis among roentgenologists, that therapeutic results were better, if the raying was applied to hyperemized structures, and a favorite method of producing this hyperemia was the employing of "medical diathermy," the attracting of blood to the structures concerned by heating them moderately but thoroughly with the help of the high frequency current.

Then Pfahler pointed out that practically unmanagable epitheliomata of the face and skull would heal under x-rays, provided that electrocoagulation was employed previous to raying. But it remained for observation of a series of vesical and uterine cancers to demonstrate that, administered under certain conditions, surgical diathermy is the most efficient preceding factor for improving the healing effect of radiotherapy.

After disagreeable experiences with total coagulation of the tumor mass in extensive cases of uterine, vesical and prostatic cancer only limited coagulation was executed in cases of this type and this interference was followed up by raying either with radioactive substances or with the roentgen tube.

The reasoning was that only the tumefaction of the involved organ should be coagulated by diathermy, while the involved vesico-vaginal or vesico-rectal septum should be left to the therapeutic influence of the rays. In case the raying should be successful, then the substitution of fibrous tissue for the malignant mass would furnish a healthy septum and thus the formation of pathologic communications between vagina, bladder and rectum would be avoided.

In the course of further observations it was noticed that raying applied shortly after electrocoagulation seemed to furnish better results than radiotherapy administered some time after the diathermy.

It therefore became the routine to coagulate malignant tumors only to a limited extent, and to administer the therapeutic rays within forty-eight hours after the electrocoagulation. In this way very satisfactory results were obtained—even in apparently hopeless cases clinical cures were accomplished—the term clinical cure is chosen because the oldest uterine case is only five years old and the oldest vesical case is of three years duration without relapse.

The partial coagulation of a malignant tumor certainly cannot be held responsible for the disappearance of the entire growth, the same may be held concerning the raying, even if one believes in the "carcinoma dose," because in the uterine cases only one hundred milligrammes of mesothorium or radium were used for twenty-four hours, and in the vesical cases two hours under a 25,000 volt machine were administered in one, and only one, seance.

In order to explain these therapeutic successes it is necessary to deviate some from our traditional conceptions.

Well substantiated doubts may be offered concerning the supposedly direct destructive action of therapeutic rays on tumor cells. If the curative element were a direct action it would follow that in each instance the rays should make an impression on a malignant tumor, which happens however in only a small minority of such cases.

If under the influence of therapeutic rays the cancer cells simply would disintegrate and the products of this disintegration be eliminated, then the raying of a cancer should increase the elimination of nitrogen, which is not the case. It is furthermore conceded by the biologists that only a functioning cell may bring about a disaminization, a decaying one is unable to do so.

It seems more along the lines of sound reasoning to assume that under the influence of therapeutic rays tumor cells may produce materials, that, if brought into the circulation, in turn excite other cell groups into the production of defensive and inhibitory ferments which put a stop to the form of activity of tumor cells which we call malignant luxuriation.

There are other facts that place this ferment theory beyond idle speculation. It is a matter of experience that if a malignant tumor is rayed and the blood of the carrier is taken during the general reaction and is then injected into another patient who is suffering from cancerous cachexia the second patient will show marked improvement.

It is not too far fetched to assume the raying produced defensive ferments in the donor, and these, if injected in the second patient, evolve an inhibitory action on the materials emanating from decaying tumor cells, which materials are the producers of cachexia. This ferment theory is also supported by another observation. It will occasionally happen that under the influence of therapeutic rays a malignant tumor will show intense and rapid luxuriation. It is a fair conclusion to assume that in such an instance the production of stimulating ferments outweighs the production of inhibiting ferments, thus causing a rapid proliferation of the tumor cells. In support of the ferment theory it may also be noted that therapeutic rays show a pronounced, favorable influence on localized tuberculosis, although the germicidal action of roentgen rays is practically nil.

That antitumoric forces exist in the human body is proved by the fact that in healthy individuals a fatty acid may be traced in the blood serum, which acid is indifferent to normal structures but shows carcinolytic qualities. In carriers of cancer, however, there is to be discovered another, a saturated fatty acid that counteracts the carcinolytic acid at a ratio of ten to one—an example of a struggle between two substances concerning the luxuriation of a cancer.

In dogs the removal of the thymus reduces the carcinolytic potency of the blood serum, while in rabbits for instance, the carcinolytic quality of their blood serum is increased by the hypodermic injection of thymus taken from the calf.

This observation illustrates the influence of endocrine glands upon the growth of malignant tumors and may help explain the fact that in human beings advanced age shows a disposition toward development of cancer, one of the contributing causes being the partial obliteration of the thymus.

Investigation of the immediate results of surgical diathermy has demonstrated that beyond the zone of ne-

crosis and sealing of the lymphatics there is created a zone of pronounced reaction, an area of aseptic inflammation, characterized by the appearance of abundant round cells and leukocytes together with the production of fibroblasts. All these are cells of high vitalistic function—it was also found that the cells composing the fibrous tissue became energized—this is proved by the fact, that these energized fibrous cells accept vital staining which they do not under ordinary conditions. It is fair to assume that cancer cells lying in this perithermic zone also become energized.

Under this increased vital potency they may produce materials which if brought into the circulation may by their systemic influence stimulate the endocrine glands to the production of defensive and protective ferments, apt to tone down the excessive luxuriation of a malignant growth.

These biologic considerations together with the clinical observations may suggest that only the decayed and decaying malignant cells ought to be destroyed by surgical diathermy, while the malignant cells that are still at the peak of their periodicity of life should be left to the influence of radiotherapy.

Summary

Surgical diathermy is a potent factor enhancing the efficiency of radiotherapy.

Electrocoagulation and raying seem to furnish the possibilities of a true chemotherapy of malignant tumors.

Raying has to be administered while the perithermic zone shows pronounced reaction.

On the Physical Principles of the Alpha Ray Therapy*

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FROM the experience with x-rays and the rays of radium, it is now generally known that the specific biological effects of rays are proportional to the energy absorbed in the tissue. This holds for any sort of radiation. Absorption of the energy of rays is accompanied by ionization and if there is a means to measure the ionization of the beam of rays entering a certain growth and the ionization after having passed through this growth, it can be calculated what amount of radiation (measured in terms of energy) was absorbed by the growth in a known time of exposure.

Since the absorption of certain types of radiation in tissue is well known, the applied dosage can be measured also by the amount of incident radiation. However, it should be borne in mind that not the amount of incident radiation in a certain part of the tissue, but the amount absorbed per cubic centimeter is decisive for the biological effects.

Referring to rays from radioactive substances, it is well known that the alpha, beta and gamma rays differ widely in their power to ionize or to produce chemical and biological effects.

From the measurements of the heat produced by radium and its successive products,[1] the total energy of the three types of radiation can be deduced. It was found that when one gram of radium with its successive products, emanation, RaA, RaB, and RaC, is used, the α-particles and recoil atoms produce 123.6 gram-calories per hour, the β-rays (electrons) give an amount of 4.7 gram-calories per hour, while the γ-rays give 6.4 gram-calories per hour.

If in medical work γ-rays alone are applied, it can therefore be stated that about 5 per cent of the energy of radium is used while 95 per cent of the energy is absorbed and converted into heat within the preparation, the glass, and the walls of the filter used.

If metallic needles filled with radium salts, or tiny little glass tubes with emanation, are applied within the human tissue, a great part of the β-rays passes through the walls and acts upon the living tissue. But even in this case where β- and γ-rays are used, the amount of radiating energy which is applied usefully does not exceed 11/135 of the total radiation, as can be seen from the figures given just above. Thus it is clear that in applying radium or emanation in sealed thin containers, even when buried within the tissue, we have available little more than 7 per cent of the total energy emitted by radium in the form of rays of all three types.

More than 90 per cent of this energy is sent out with the α-particles. These have a very high ionizing power but cannot even penetrate a glass tube the wall of which is 0.5 mm. thick. Therefore, all these rays are readily absorbed within the crystals of the radium salt or in the walls of the container.

In air of atmospheric pressure, α-rays can travel several centimeters; α-rays of RaC having a velocity of 19,200 km. per second traverse 7 cm. of air before they lose their ionizing power. Slower α-rays, like the α-rays of radium itself (15,000 km. per sec.) traverse not more than 3.3 cm. in air before they lose their ionizing quality. Accordingly 7.0 and 3.3 cm. are called the "ranges" of the α-particles of Ra C and of Ra. The fastest α-particles are those of thorium D; they have a range of 8.6 cm. in air.

The enormous difference between the respective ionizing powers of α-, β-, and γ-rays is well known. Disregarding the differences in ionization at the beginning and at the end of the path of an α-particle, it can be said that approximately 30,000 pairs of ions are created in every single centimeter of the path of an α-particle in air. The more penetrating types of β-rays create not more than 80 to 300 ions per cm. of their path in air. Gamma rays produce 1 to 2 pairs of ions per cm. of air.

Ionization and biological action seem to go parallel, as far as we know. It might therefore be very effective to utilize the intense ionization produced by α-rays for therapeutic purposes. An external application of radium could never serve this purpose. Experiments have been made with flat radium applicators using very thin mica screens, but even when the α-rays passed through the mica window they could not penetrate the human epidermis.

The range of α-rays in solid and liquid substances is extremely short. The α-particles of Ra C having a range of 7 cm. in air, are stopped in glass at 0.04 cm. distance. In water and other liquids of about the same stopping power they have a range of about 0.06 cm. The α-particles of the other elements of the radium family are much slower. In the average they would not traverse human tissue beyond a depth of .05 mm. This is a great obstacle in the way of using them for therapeutic purposes.

Open radium crystals which give off a certain amount of α-radiation should not be buried in human tissue and even the thinnest possible screens would cut off more than 90 per cent of the α-rays. This is the main reason why α-rays have not been used for therapeutic purposes to any great extent.

Nevertheless there are several ways of applying α-rays to the human body which are physically possible.. One of them has been in use since the infancy

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of radiology, i.e., the use of radium emanation in inhalators and for bathing and drinking. In all these cases a radioactive gas with a strong α-radiation is mixed with air or water passed through the body. Another method consists of intravenous injection of small quantities of radioactive substances in solution. The latter method was developed mainly in this country and will be discussed later.

In both cases the biological effect depends upon:

(1) The time of exposure, or in other words, the time the radioactive substances are acting in the body. This in turn is dependent on the radioactive decay of the substance used.

(2) Specific absorption of the radioactive substances in certain parts of the body.

(3) General circulation of the system.

Two other possible ways of internal use of radioactive substances may be mentioned: Administration per os and per clysma. In these cases the solution containing radium emanation, thorium X, or other substances, passes through the digestive system in a relatively short time. The radioactive substances can hardly affect the living cells by direct α-radiation, because α-rays are absorbed in the liquids covering the mucous membranes.

On the other hand, it is very doubtful whether β- and γ-radiation of small quantities of radium emanation, etc., as they are used internally, have any noticeable effect. Only experimentation can show whether or not sufficient quantities of the substances pass into the lymphatic system.

It can be foreseen that only a small fraction of the swallowed substances remains in the system. In drinking radium water a very large part of the emanation is ineffective for the same reason. Furthermore, exhalation and the process of swallowing undoubtedly remove a very large fraction of the emanation from the system.

If emanation is inhaled, the lungs are filled with a certain quantity and the radioactive deposit (RaA—RaC) is formed on the inner surface of the lungs. Here certainly the α-rays can act biologically to some extent. But the main action of these rays takes place within the blood. Blood absorbs emanation to about the same extent that water does[2] and it has been shown by different observers that in persons who are exposed to emanation for several hours the blood contains a certain amount of emanation.

The elimination of emanation is completed two to three hours after the patient has left the "Inhalatorium." Exhalation removes practically all the emanation. A very small fraction of emanation is eliminated through the renal system (Lagneur).

Entirely different is the effect of the intravenous injection of radioactive substances like radium, thorium X, polonium. Thorium X decays in 3.6 days to one-half of its original value, polonium in 136 days. Radium can be considered as being constant (half value period 1,580 years). Thorium X and polonium have been used in injections, but these substances cannot be obtained very readily or in quantities sufficient for medical purposes.

Injections of radium solutions have been tried in many hospitals abroad and in this country with good results. Soluble radium salts (bromide or chloride) of highest purity (without any barium) are used for this purpose. They are dissolved in distilled water and some sodium chloride is added to obtain a solution of the same osmotic pressure as the blood. Ordinarily 2 cc. of this solution are injected by means of a hypodermic needle. The quantity of radium in one injection varies from 5 to 100 micrograms.

Several authors[3] have shown that injected amounts of radium are retained within the system for a considerable time, at least partially for two weeks. This prolonged exposure certainly enhances the efficiency of even very small doses within the blood system. Elimination is so slow that the whole injected amount can act fully for a time sufficiently long to influence the living cells.

From the standpoint of the physicist, the injection of radium in solution is preferable to all other possible methods of internal administration of radioactive substances. It seems to be the most economic use of radium. It is brought directly in contact with the blood and α-radiation can act upon the blood corpuscles. Losses that take place in inhalations of radium emanation, drinking cures and other ways of administration, as per os, are avoided.

Summary

The physical qualities of α-, β- and γ-rays are discussed and it is shown that the ionizing power of the α-rays can be utilized medically best in intravenous injections of pure radium solutions. In all other possible ways of internal administration of radioactive substances, a lesser percentage of the given doses is utilized. It is shown that α-rays can act upon living cells of the human body only when the radiating substance is mixed with the blood or lymph.

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Ultra Violet Radiation*

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ULTRAVIOLET travels in straight lines so long as it remains in a uniform medium. (In the case of fused quartz rods bent in various curved shapes, the ultraviolet follows mostly the path of the rod because of the difference in the angles of refraction of quartz and air.)

The term *ray* is applied to the rectilinear path along which ultraviolet travels, in any direction, from a point in the generating tube. Since the tube emits ultraviolet in all directions, then any straight line from the tube constitutes a ray.

A collection of rays, proceeding from or toward a point, is termed a pencil.[1]

When the ultraviolet rays proceed from a point, the pencil is termed divergent; when toward a point, convergent. Thus, the ultraviolet pencils emitted by the air cooled and water cooled lamps are divergent; but when rock crystal lenses are used in the optical path of these pencils, they may be made convergent.

Coblentz, Long and Kahler studied the variation of irradiation parallel with the axis of the quartz tube. They used an R.U.V.[2] tube, which is in every way similar to the "Uviarc" tube of the modern ultraviolet equipment, and they measured the radiation intensity at what was judged by them to be the optical center of the tube, and at intervals of five centimeters to the right and to the left of this point. A specially constructed thermopile was used for the measurements, which they reported in terms of galvanometer deflection, as per the accompanying diagram (Fig. 1). These observers remark "that for a length of about 10 centimeters, which constitutes the light giving portion of the lamp, the intensity is fairly uniform."

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Intensity of Radiation

By the intensity of radiation is meant the amount of ultraviolet received by unit surface. It depends upon:

(1) the distance of the tube;

(2) inclination of the exposed surface to the direction of the rays.

For ordinary light, as for x-ray, the intensity diminishes as we recede from the source. If the luminous source be a point, the intensity diminishes as the square of the distance increases. Using the digit "1" to signify the quantity of light falling upon a given surface at a distance of a foot or yard, the quantity falling on it at a distance of 2 feet or 2 yards is 1/4, at a distance of 3 feet or 3 yards it is 1/9, at a distance of 10 feet or 10 yards it would be 1/100, and so on. This is the meaning of the law of inverse squares as it applies to light and x-rays.

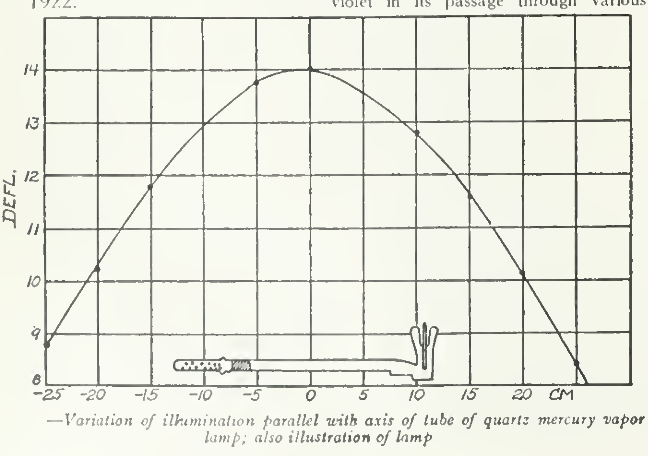
What holds true for x-rays and some visible light rays, holds true also for ultraviolet rays in a perfect vacuum. That is, in vacuum, ultraviolet intensity obeys the inverse square law. But owing to peculiarities in the absorption of this energy by the various constituents of the air, the law of inverse squares cannot always be used with entire accuracy in the usual clinical application of ultraviolet. It is, therefore, imperative, that there be studied and understood the changes incident to ultraviolet in its passage through various media. Says Lyman, in his *Spectroscopy of the Extreme Ultraviolet*, in the section devoted to the absorption by gases: "The air was the first gas whose absorption was investigated by Schumann. It will be well, therefore, to begin with a general account of its behavior in the region of extremely short wave lengths before turning to the absorption of other gases.

"Kreusler[3] found that a column of dry air 20.45 cm. long, free from carbon dioxide, absorbed 8.8 per cent of the light at wave length 1860. At wave length 1930 the absorption was so small that it could not be measured.

Schumann[4] examined the effect of change of thickness of the absorbing column; he employed the device which has already been described whereby the length of the absorption layer could be varied continuously. He used as source a discharge tube giving the spectrum of carbon dioxide. He found that the limit of the spectrum remained in the neighborhood of wave length 1780 while the path was reduced from 15 mm. to 8 mm. It was only when a length of 4 mm. was reached that the spectrum began to extend. From this point onwards the extension was much more rapid; with an air thickness of 0.5 mm. the last visible wave length was in the neighborhood of 1630. He carried his observations to air strata as thin as .05 mm. and showed that under these circumstances the spectrum stretched considerably beyond 1600. As the dispersion of fluorite had not been experimentally determined at this time, Schumann's wave lengths were obtained by a process of extrapolation, a method which yielded only approximate results to the neighborhood of 1600 and which completely broke down on the more refrangible side of this region. However, measurements on the absorption of air carried on at Harvard University[5] by a method in which the limiting wave lengths could be accurately determined, have served to confirm Schumann's observations to a marked degree.

"It is important to note in this connection how short must be the stratum of air in order that the region in the neighborhood of 1600 may be transmitted. Before considering the behavior of the air at the more refrangible limit of the Schumann region it will be most convenient to take up the absorption of some of its constituents.

"*Nitrogen* — Kreusler[3] found that nitrogen absorbed 2.2 per cent at wave length 1860; the presence of small



—Variation of illumination parallel with axis of tube of quartz mercury vapor lamp; also illustration of lamp

quantities of nitrous oxide (NO) increased the value very considerably. Schumann[1] states that 'nitrogen proves itself very transparent, even beyond 1620, yet it absorbed particular wave lengths very energetically.' Experiments with the grating vacuum spectroscope[5] and a vessel 9.14 mm. long (see p. 48) showed that at atmospheric pressure nitrogen produces a very slight absorption extending continuously from 1800 or thereabouts to 1250. The strength of this absorption increases regularly with decrease in wave length, but even at the most refrangible end of the spectrum it is very small indeed. The energetic, selective action mentioned by Schumann was not observed.

"*Oxygen*—This gas is the dominating factor in determining the transparency of the air. Kreusler[3] ascribes an absorption of 32.5 per cent at 1860, 6.2 per cent at 1930, and a negligible absorption at 2000; the column was as usual 20.45 cm. long. Schuman makes the following statement: "Oxygen absorbs the rays in the neighborhood of 1850 in a series of clearly resolved groups of lines fourteen in number. These groups, which are of band-like form, constantly approach nearer one another with the deviation and are shaded off toward the red. Complete absorption is found with the most refrangible of them. It is this which makes the air opaque for all rays beyond 1850."

"*Carbon Dioxide*—Kreusler[3] attributes 13.6 per cent absorption to this gas at 1860. Schumann[6] states that the absorption spectrum is similar to that of oxygen with an indication of a 'rhythmical series in the shape of inverted groups of lines, but the end of this series is considerably more refrangible than that of oxygen. Accordingly, total absorption begins at a shorter wave length.' The observations made with the vacuum grating spectroscope are in very fair agreement with the statement made by Schumann, except that the rhythmical series were not observed near 1850. There were also some indications that maxima and minima of absorption do occur considerably on the more refrangible side of this position.

"*Water Vapour*—Data on this substance in the extreme ultraviolet are lacking. Schumann did not succeed in obtaining any information. Experiments with the grating apparatus indicated a maximum of absorption between 1700 and 1600, with some promise of transparency on both sides of this region, but the results are rather doubtful. The formation of opaque films of water on the windows of the absorption cell is the factor which causes the uncertainty."

From the studies presented it is observed that ultraviolet energy is materially absorbed for the wave lengths more refrangible than 2000 units; and that the longer wave lengths, such as are designated biologic in connection with the air cooled lamp suffer slight or no impairment. We may properly generalize the situation by saying that the law of inverse squares applies with clinical exactness in biologic therapy; but not so in bactericidal therapy. That is, in the use of the longer wave lengths of the air cooled lamp, the inverse square law obtains; whereas, in the use of the extreme short wave lengths of the water cooled lamp, the effect is lost if the distance of application exceeds the limit of air absorption, so that the law of inverse squares cannot here be utilized.

Cosine Law

Lambert's cosine law applies pertinently to ultraviolet radiation, for which it may be said that "The intensity received by a surface varies as the cosine of the angle of incidence." (The basis of this law, like that for the inverse square law, is purely geometrical and need not be reproduced here.) When the ray of ultraviolet strikes the radiated surface exactly tangential, the intensity is maximum; when the incident ray is nearly parallel with the surface irradiated, the angle approaching 0 degrees, the intensity is minimum, according to the following table which shows the approximate percentage of ultraviolet intensity according to angle of incidence of central ray (original intensity assumed 100 per cent):

Table I.

Angle of Incidence	Intensity
90°	100.00
85	99.6
80	98.7
75	96.6
70	93.9
65	90.6
60	86.6
55	81.9
50	76.6
45	70.7
40	64.2
35	57.3
30	50.0
25	42.2
20	34.2
15	25.8
10	17.3
5	8.7
1	1.7

In order to receive the maximum intensity of ultraviolet irradiation, the plane of the surface exposed should be as nearly at right angles to the central ray as the natural configuration of the part will permit.

Combining the inverse square law with the Lambert cosine law, as they apply to long ultraviolet wave lengths (biologic or air cooled), we find that

The intensity of biologic ultraviolet irradiation is proportional to the specific intensity of the source, inversely proportional to the square of the distance, and proportional to the cosine of the angle which the central ray makes with the plane of the exposed surface. This may be expressed in a formula as follows:

$$E = \frac{I \cos a}{d^2}$$

where E = energy falling on a surface;
I = intensity of ultraviolet as determined by wattage;
Cos a = Cosine of angle made by central ray and normal to surface irradiated; and,
d^2 = square of distance separating tube from surface rayed.

Abroad, the custom prevails to speak of the term E in Hefner units, borrowed from usual photometry. There may be an objection against the usage of a term conveying a meaning of illumination or candle power in connection with an energy that is invisible: and since the actinotherapist should ever remember that the rays responsible for most of the clinical effects are not seen, it is fitting that a unit be adopted to replace the meaningless (as applied to ultraviolet) Hefner-Kerze.

Mutual Independence of Rays

From geometry we find an expression of ray action which says that "the rays in a pencil of ultraviolet energy are mutually independent, or, the effect of a pencil of rays is simply that due to their sum."

This law is important as an index to the necessity for selective ultraviolet filtration; a means that needs yet to be developed for clinical adaptation.

The ultraviolet rays present in mercury arc spectrum are many and originate from band sources. Most important are the wave lengths as follows (taken from the frequency spectrum previously rendered[7]):

Wave Lengths of Important Ultraviolet Bands—

4000	2925
3907	2894
3821	2804
3752	2753
3663	2700
3650	2654
3544	2576
3391	2536
3342	2482
3126	2446
3022	2412
2967	2378
	2225

A study of the frequency spectrum shows these various bands to present vastly different intensity values; and it would seem that the feeble intensity of some, as compared to the strong intensity of others, would preclude the usefulness of certain bands for therapeutic application. But this important law seems definitely proved: *The biologic effect of the different rays is not proportional to the energy in these rays, though, of course, the effect of ultraviolet is dependent upon the amplitude of the wave, its intensity and its length*[8]. To illustrate, observe the frequency spectrum and compare the energy intensity of two bands, say 3650 (group) and 2536. The first group is more intense than the second; yet the second is many times more bactericidal than the first. In other words, the quality of bacterial destruction is a function of the amplitude, intensity and length of ultraviolet characterized by 2536, as against 3650; though the actual bactericidal capacity of the 2536 band is a function of its own intensity. That is, when the intensity of the mercury vapor arc is increased by furnishing a greater energizing wattage, the specific activity of each band is proportionally increased; but the chemical work accomplished by any individual band group has no obvious relation to the energy represented by each band. It is for this reason that the watt has not and should not become the unit of ultraviolet treatment. The watt expresses intensity of the energy; but we are interested in knowing the biologic efficacy of each individual band. With this determined it is an easy matter to increase the effect by augmenting the intensity (wattage) or lengthening the treatment time.

Distribution of Actinic Effects in the Spectrum

In keeping with the theme just propounded, Mast, in his book, *Light and the Behaviour of Organisms*, devotes an excellent study to the topic, as follows: "That light causes profound changes in chemical compounds is a matter of common information to all familiar with the process of photography. The fact that the shorter waves of the spectrum, the ultraviolet, violet and blue are chiefly active in causing changes in the halogen salts of silver and various other metals used in this process, is at least in part responsible for the idea that photochemical changes in general are largely if not entirely brought about by the action of the shorter waves, which are usually referred to as the actinic rays.

Photochemical reactions are far more numerous in both the inorganic and the organic realms than is generally supposed. Davenport brought together many instances under the following heads: synthetic, analytic, substitutional, isomeric, polymerismic, fermentative effects of light. Recent investigations have made known others which are of especial interest to us. Most important among these are numerous reversible reactions, reactions which take place in one direction in daylight or in light of a given wave length, and in the opposite direction in darkness or in light of a different wave length.

"The following reversible equations (Table II) are referred to in a recent paper by Stobbe (1908) on photochemical reactions. The first five are quoted by Stobbe, the rest were discovered by him. In these equations the arrows indicate the direction in which the reaction takes place in the different conditions of light with which they are labeled. In the first equation, for example, the reaction proceeds toward the right and toward the left in darkness.

Table II

1. $2\ AgCl \underset{dark}{\overset{light}{\rightleftarrows}} Ag_2Cl - Cl.$

2. $2\ C_{14}H_{10} \underset{dark}{\overset{light}{\rightleftarrows}} C_{28}H_{20}.$

3. $5\ AgI \underset{Dark}{\overset{light}{\rightleftarrows}} AgI_3 - 2\ Ag_2I.$

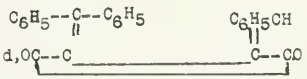
4. Tetraphenyldihydrotriazin.

   White $\underset{dark}{\overset{light}{\rightleftarrows}}$ rose red.

5. Dimethyloxalessigesterphenylhydrazon.

   White $\underset{dark}{\overset{light}{\rightleftarrows}}$ citron yellow

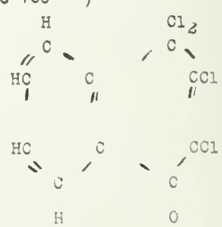
6. Triphenylfulgid,



   Orange yellow $\underset{dark}{\overset{light}{\rightleftarrows}}$ light brown.

   Orange yellow $\underset{\text{red or yellow (550 to 700}^{uu})}{\overset{\text{blue or violet (440 to 550}^{uu})}{\rightleftarrows}}$ dark brown.

7. B-Tetrachlor-a-ketonaphtalion,



   White $\underset{\text{yellow green}}{\overset{\text{ultra-vielet}}{\rightleftarrows}}$ violet.

"In the last two equations it is clearly shown that the longer waves as well as the shorter are actinic. Stobbe investigated the reactions of numerous so-called fulgides in the different rays of the spectrum ("Steinheilschen Spectrographen") and found seventeen which behave much like triphenylfulgid. There is however considerable variation as to the specific effect of the rays in the different forms. In general the shorter waves cause the fulgides to become darker in color, while the longer ones cause them to become lighter. But in some it is the violet which produces the dark shades, while in others it is the ultraviolet or the blue. "Je mehr sich die Farbe eines Fulgides vertieft, je weiter sich die Absorption eines Fulgides nach dem rothen Ende des Spectrums erstreckt, um so weiter ruckt auch die Erregungszone nach derselben Richtung vor" (1908, p. 31).

"In white light the fulgides turn dark, just as in monochromatic light, but strange as it may appear the reaction is much less pronounced, even if the white light has more of the effective rays than the monochromatic light of any given region in the spectrum. The relatively feeble effect of white light must be due to the presence of the longer waves, which, as represented in the equation

above, tend to produce the lighter shades and consequently retard the production of the darker. It may be well to call attention to the fact in passing that the investigations of Lubbock on Daphnia, of Wilson on Hydra and of Weisner on some of the higher plants show that as in the fulgides, monochromatic light consisting of certain rays is more effective in causing reactions than the same light in combination with other rays.

"It is evident from the last two equations that the longer rays as well as the shorter may have a specific photochemical effect. Triphenylfulgid, e.g., is changed from dark brown to orange yellow by the longer waves and not by the shorter. There are many other reactions which are induced only by the longer waves. Among the most important of these the process of photosynthesis in plants furnishes an excellent example. The maximum for this process lies in the red very near the Fraunhofer line C. This is not solely due to the fact that the rays in this region are more readily absorbed than those in the adjoining regions, for the violet rays are also absorbed, and here there is no appreciable effect on photosynthesis. In solutions which contain ferrocyanide or certain other coloring matter the longer waves are also more effective than the shorter, and pure ozone, which is changed to oxygen only in the ultraviolet, is similarly acted upon by the visible rays if chlorine be added. These various examples inevitably lead to the conclusion that while the shorter rays may induce chemical changes in more substances than the longer, they cannot be considered as the only actinic rays. The relative efficiency of the different rays depends first of all upon one or more of the compounds between which the photochemical reaction is taking place, but it also, at least in certain cases, depends upon the presence of substance in which no apparent change is taking place.

"Many of the photochemical reactions are exothermal. For example, the light conditions which induce the fulgides to become dark are much more effective in lower temperature than in higher. According to Stobbe it requires nearly ten times as much light energy to produce a given change at 100° as it does to produce the same change at 87°. A decrease in heat energy, therefore, produces the same effect as an increase in light energy, a statement which at first thought appears self-contradictory. As a matter of fact, however, it merely demonstrates the independence of these two forms of energy in producing chemical reactions.

"It is evident from what has thus far been presented that the actinic distribution in the spectrum is not proportional to distribution of energy. There are many well-known photochemical reactions which occur only in ultraviolet, the region of the spectrum which contains least energy.

"Precisely how light produces chemical changes is unknown, but it is clear that only those rays which are absorbed can be effective. The efficiency is however not proportional to the absorption. According to the excellent researches of Luther and Forbes (1909), the reaction between quinine and chromic acid is only affected by the rays absorbed by the chromic acid. Only about four per cent of the light absorbed by the quinine is changed to chemical energy. The ultraviolet and violet are most readily absorbed, but the green is most efficient, i.e., a greater amount of chemical action is caused by a given amount of light energy absorbed in the green than by the same amount absorbed in the violet and ultraviolet, showing clearly that the efficiency is not proportional to the absorption. The same is true in case of photosynthesis, which is supposed to be due to the action of light absorbed by the chlorophyll. Chlorophyll dissolved in alcohol has, according to Reinke (1884), a prominent absorption band in the red, a weak band in the orange, the yellow and the green, while from $500^{\mu\mu}$ on. i.e., in the blue and violet, practically all light is absorbed. The maximum rate of photosynthesis however, takes place in the red, from which it decreases rapidly in either direction, so that beyond the green in the region of maximum absorption there is scarcely any photosynthesis."

Bunsen-Roscoe Law

The effect produced by each ultraviolet band, or by each group of ultraviolet bands (region, such as near or far ultraviolet) is in part expressed by the law of Bunsen and Roscoe, as follows: The effect is proportional to the product of the intensity multiplied by the duration of irradiation: or, in symbols:

$$E = K\ i\ t$$

where E=effect of energy
K=constant proportionality factor for the particular reaction under consideration,
i=intensity (wattage)
t=time, in seconds.

Which means that at a given distance, the photochemical effect derived is dependent upon the time of exposure duration (when the intensity is constant). But while this is true of isolated chemical reactions, it is not true of gross biologic results. For instance, at a distance and intensity where the exposure of a skin surface leads to a stimulative erythema, doubling the exposure time does not mean that there will accrue twice the amount of stimulation; it is usually the case that a blistering or desquamative erythema will result instead.

Where the effect of the irradiation is displayed on a constantly changing surface, as the capillary blood and lymph streams during a systemic exposure, then the law of Bunsen and Roscoe holds with greater accuracy. In this case, the reddening of the skin is not essentially the reaction sought; but, rather, the chemical changes that take place in the fluids.

Actinometry

Actinometry has been used as a general term for the measurement of radiation, more especially solar radiation; but it is fittingly restricted to the measure of the intensity of radiation by chemical means. Very obviously, there can be no absolute value in the significance of the term; for, as ultraviolet radiation of every wave length is capable of affecting some *one* particular chemical reaction, and the ultraviolet spectrum issuing from the therapeutic lamps is quite extensive, any actinometric measure would be only an index of the chemical activity of one group of wave lengths. So that any actinometer is of value only for a particular outfit, and then its use is greatly limited because it fails to register the patient's susceptibility. So that the calomel actinometer of Eder, and the various photographic sensitive papers and pastels introduced from time to time, have met with very little support from the clinic because of their extremely diminutive scope.

After all, actinometers depend for their accuracy on the "reciprocity law" of Bunsen-Roscoe; that a photochemical change will be in general greater the greater the intensity of ultraviolet. This has been found valid in the laboratory for isolated photochemical reactions; as for the chlorine-hydrogen actinometer, the ferric oxalate reaction, and certain silver salts. But the biologic reactions of the clinic are multiple and often antagonistic; which precludes the complete utilization of the "reciprocity law," as elsewhere discussed.

Variations in Methods of Ultraviolet Application.

Reviewing the changes produced by ultraviolet radiation in its passage from the equipment to the surface irradiated, we find that the effect can vary according to

(1) Initial energy intensity (wattage);
(2) Distance of the tube (inverse square law);
(3) Inclination of the exposed surface to the direction of the

central ray (Lambert's Cosine Law);
(4) Dominant wave lengths of the source (long air cooled, short water cooled);
(5) Time of the exposure;
(6) Reaction sought.

It is manifestly difficult to combine all of these variable factors into a single clinical unit; and it is unnecessary that they should be so combined. The therapist need only realize certain fundamental premises, as above outlined, from which there may be deduced a tangible working basis, as follows:

For the air cooled lamp, representing essentially the longer ultraviolet wave lengths unimpaired by passage through air:

(a) Superficial biophysical action;
(b) Deeper biophysical action.

Superficial biophysical activity is confined to the skin layers. It is desired here to produce the quickest result in the shortest interval of time, for which there may be used:

(a) High voltage (wattage intensity;
(b) Short tube—lesion distance;
(c) Short time exposure.

A good working formula would be:
Volts, 90;
Distance, 10 inches;
Time, from 30 seconds to $1\frac{1}{2}$ minutes, depending upon degree of reaction sought.

This insures the expenditure of the energy on the skin surface, minimizes the amount absorbed by the lymph and blood streams, and, consequently, practically eliminates "systemic" effects. It is the basis for air cooled technique in which the dermatologist would be especially interested.

By deeper biophysical action is meant the change that develops as the result of irradiating a surface for a longer time with the view of affecting particularly the blood and lymph (and cellular chemistry). For this, it is best to recommend:

(a) Low voltage intensity;
(b) Long tube-lesion distance;
(c)) Long time exposure.

A formula, say, such as
Volts, 70;
Distance, 40 inches;
Time, from 3 minutes to 10 minutes.

Here the skin reaction is minimized (owing to longer distance and less intensity), so that the fluids of the area receive the greatest amount of irradiation before discomfiture can accrue from the epidermal changes.

Each subsequent exposure, owing to the tolerance that develops as the result of pigment changes invoked in the skin, may be increased. Abroad, the custom has been to diminish the distance and thereby attempt to profit by the inverse square law. Shortening the distance, as we have seen, tends to bring shorter wave lengths into play;[9] so that instead of increasing alone the intensity of the radiation, there is a change in the spectral formula reaching the skin. It is better, therefore, to keep the distance fixed, and to increase the exposure time only. This augments the effect without changing the spectral value.

For the water cooled lamp, in which water cooled lamp is indicated for those biochemical reactions in which the short wave lengths are essentially useful. Short wave lengths can reverse the direction of chemical reactions that operate under long (air cooled) wave lengths of ultraviolet. And since the law of inverse squares does not obtain in the case of short wave lengths, unless the tube-skin distance is less than 15 centimeters (about $5\frac{1}{2}$ inches), the effect produced will not be different from that gained by the air cooled lamp. Systemic irradiation with the water cooled outfit, if used for the special biochemical effect of the shortest wave lengths, must therefore, be at very close range.

A summary of the laws and their significance in establishing a therapeutic basis, is:

Law	Air cooled lamp	Water cooled lamp.
Inverse Square	Applies at long range	Does not apply at long range.
Cosine Law	Applies	Applies without applicators.
Bunsen-Roscoe Law	Applies in part only	Applies in part only.
Mutual independence of rays	Do not change distance in treatment. Simply increase time.	Keep contact for bactericidal effect. Not more than 5 inches distant for systemic irradiation.

we are interested especially in the shorter wave lengths much impaired by air absorption, the technique must involve the closest practical range, which may be:

(a) Contact;

(b) Approximate.

By "contact," is implied an established continuity between the lens of the casing and the focal lesion to be treated. Continuity may be obtained by direct application, or by the interposition of various applicators, such as tubes, quartz lenses, quartz rods, etc. By "approximate" is meant any distance less than 15 centimeters between the lense and the surface to be treated. It is the method used for the "systemic" application of the water cooled lamp, the casing being gently swept over the entire nude front and back of the patient, in a fashion to insure complete irradiation. It is imperative to observe that "systemic" irradiation with the

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1. Latin, "pencillium," a painter's brush, from the obvious similarity between light rays converging toward a point, and the converging hairs of painter's brush.

2. Both the R.U.V. and Uviarc tubes are produced by the Cooper Hewitt Company, Hoboken, N. J.

3. Ann. d. Phy. 6:418, 1901.

4. Smithsonian Contributions, 1413, page 29.

5. Lyman, Astrophysical Jour. 27: 89, 1908.

6. Smithsonian Contributions, 1413, page 16.

7. Jour. Radiol. 3:380, Sept. 1922.

8. This significant law should be carefully appreciated by reason of its great bearing in therapeutic accomplishment.

9. For the loss of radiation effect because of ray inclination see Table I.

The Roentgenological Aspects of the Visceral Crises*

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THE roentgenologist has not infrequently to report negative findings to the physician or surgeon who has diagnosticated gastric or duodenal ulcer or appendicitis, or renal calculus or gall stones. Negative findings are rarely valued by the patient and are reluctantly received by his medical or surgical advisors. Nevertheless the roentgenologist must spend unusual time, care and skill in arriving at these negative findings in the face of symptoms and a history which may seem convincing of other conclusions. An added difficulty lies in the fact that gall-stones in more than 50 per cent of cases give negative findings as does also chronic appendicitis excepting for the accurate localization of tenderness on palpation under screen inspection.

The disadvantages of the negative report may be minimized by a study of the less frequent causes of abdominal pain. These causes in general are known to you all but are usually disregarded, as lying within the province of the internist and as without roentgenological significance. Such are the visceral crises of the erythemas, of angioneurotic edema, of tabes dorsalis, of mucous colitis, and especially of abdominal angina. There are of course other causes of abdominal pain not the subject of this paper such as spondylitis, epigastric hernia, adhesions, obstruction, neoplasm, tuberculosis, pancreatitis, mesenteric thrombosis, etc., and negative findings may be made positive sometimes if we know how and when to look.

Although these various causes of abdominal pain are comparatively rare, even in the aggregate, yet any individual case may be of the highest importance. Furthermore the roentgenologist should be familiar with them as a matter of diagnostic culture just as he must know rare bone pathology such as multiple myeloma, Perthes' disease, osteogenesis imperfecta, osteomalacia, osteochrondritis dissecans or ostitis fibrosa.

In our series of 913 cases of abdominal pain we find 4 cases of the visceral crises of the erythema, 2 of the intra-abdominal type of angioneurotic edema, 1 of the gastric crisis of tabes, 13 of mucous colitis and 10 of abdominal angina.

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 6, 1922.

Visceral Crises of the Erythemas

These are usually described briefly and inadequately in textbooks and even in large works of reference under the head of Henoch's purpura. The most satisfactory description with case records which I could find was in three remarkable papers by William Osler in the American Journal of the Medical Sciences—one in 1895 and two in 1905, and in Lockwood's *Diseases of the Stomach*. Osler collected in his own practice 29 cases, all under 20 years of age. All had attacks of severe abdominal or lumbar pain lasting a few hours. Attacks recurred at irregular intervals of weeks, months or years. They were usually accompanied by vomiting of bloody material and were also characterized by a diarrhea with the passage of blood. When the colics were lumbar, the urine usually became bloody. Is it any wonder, therefore, that these cases would be confused with gastric ulcer, appendicitis, renal stone or some organic intestinal affection, and nowadays referred to the roentgenologist for demonstration?

Osler states (American Journal of the Medical Sciences, May, 1974, p. 751 and p. 754), "The possibility of mistaking these visceral crises for appendicitis or intussusception or obstruction of the bowel, and handing the patient over to the surgeon for operation, is by no means remote. In Case II of my series one attack was unilateral, and of such severity that the physician who was called in, knowing nothing of the previous history of the case, diagnosed renal colic. In Case XX the child was supposed to have appendicitis and was admitted to the surgical ward. Fortunately the skin rash was noticed, the pain subsided, and he was transferred to the medical wards. The association of the colic with the passage of blood per rectum may, of course, lead to the diagnosis of intussusception. * * * "The practical lessons to be drawn from these three cases in which laparotomy was performed are: First, that in children with colic the greatest care should be taken to get a full history, which may bring out the fact of previous attacks, either of skin lesions, of arthritis, or of intestinal crises; and secondly, to make the most careful inspection of the skin for angioneurotic edema, purpura, or erythema. It is also to be borne in mind that recurring colic may be for many years the sole feature of this remarkable disease. * * * The colic is the most constant of the visceral manifestations, occurring in twenty-five of the twenty-nine cases in my series. * * * The examination of the cases of Dr. Sutherland and Mr. Barrows confirms the view that the colic is due to infiltration of the intestinal wall with blood and serum."

I do not know of any report of roentgen findings in such cases. It is altogether probable that the peristaltic behavior of the gastro-intestinal tract may be altered in some characteristic manner. This is a small untouched field for future research.

Angioneurotic Edema

Osler considers that there is a close relation between the visceral manifestation of angioneurotic edema and the erythemas. The angioneurotic cases, however, are found at any age. In the Collected Papers of the Mayo Clinic, 1915, Crispin presents a most excellent summary under the title of *Visceral Crises in Angioneurotic Oedema* in which he quotes largely from the forementioned papers of Osler and adds much original matter from the abundant material of the Mayo Clinic. Crispin states: "A large number of the patients suffering from visceral crises, particularly of the erythemic, pupuric, angioneurotic group, are advised to have surgical operations, and many of them sooner or later submit to abdominal surgery, from which they do not obtain desired relief. * * * These visceral or gastro-intestinal crises may be so severe at first sight as to cause concern, and they may be without external clues in the nature of lesions of the skin. If the history is not carefully taken, the hurriedly called physician may easily be misled into thinking that the trouble must be due to the gall-bladder or appendix, or at least something that should be taken out. * * * There is another type probably resulting from the same primary cause that is occasionally mistaken for appendicitis or appendiceal abscess in which the onset and disappearance of pain are more gradual. A swelling often appears in the lower right abdomen, which suggests appendiceal abscess. * * * Three cases of induration of the cecum and adjacent gut have been observed in the operating room by W. J. Mayo. Before operation, because of the timefaction, these cases had suggested appendiceal abscess. The induration was found in the cecum and in the appendix without sufficient cause. These patients

got well with striking rapidity. A history of swelling of the skin was obtained afterward."

A further quotation from Crispin may be made because it gives the only record of roentgen findings in these cases that I am acquainted with: "Roentgenograms showed * * * a lesion of the stomach at or near the pylorus. After this examination of the stomach and while still in the dressing-room, the swellings were observed coming out. Within ten minutes thick, raised, hardened areas the size of half a dollar were noted on the thigh. Further examination revealed areas, nearly as large as the palm of the hand, over his back. Though the angioneurotic condition was recognized, because of the history of hematemesis and roentgen findings exploration was advised. At the operation nothing was found in the stomach. The gall-bladder was removed, but, when opened, revealed doubtful pathology. An obliterated appendix was also removed. One year later the symptoms were the same as before operation without noticeable change in any characteristics. The lesion at or near the pylorus reported by the roentgenologist was probably a visceral swelling. Seventeen months later the patient's physician reported attacks of abdominal pain and skin manifestations, the same as before. The last attack of pain was of the usual type, being in mid-epigastrium, severe, lasting from seven in the evening until half past one, during which time the patient was given one-half grain of morphine. * * * A diagnosis of visceral crises of angioneurotic type should not be made until careful examination has excluded or made independent surgical causes. In this, roentgenologic examination of the gastrointestinal tract is valuable negative evidence."

Mucous Colitis

This may be accompanied by visceral crises of great severity, which have many times been mistaken for appendicitis or some other intra-abdominal condition. We have frequently seen a thin streak of barium persisting in the colon after evacuation in these cases and we believe that this appearance may give the roentgenologist a clue to the true cause of some of these cases of abdominal pain.

The Gastric Crises of Tabes

This, although much rarer than the foregoing group is by far the best known and only occasionally reaches the x-ray department. It is roentgenologically silent.

Abdominal Angina

This is much the most important and frequent of the group giving visceral crises below the diaphragm. While the crises of the erythema occur in the young those of angina are found in the latter half of life.

One of these patients may come in with a history suggestive of gastric or duodenal ulcer; another with a history indicative of gall stones, and yet another may give a history pointing towards appendicitis. But these patients will have no ulcer, no gall stones, no appendicitis. In due time they are likely to die in classical attacks of angina pectoris. But before this final tragedy they are more than likely to be referred to the roentgenologist for a demonstration of the ulcer, the gall stones or the abnormal appendix. In the face of a convincing history, the roentgenologist may strain his eyes into seeing some slight niche, some peristaltic anomaly, some deformity of the duodenal bulb, some faint ring shadow of a nebulous gall stone or some peculiarity of an unsuspecting appendix. If finally a roentgen report of negative findings is submitted, the surgeon is likely to view it as one more piece of evidence of the limitations of the x-ray. Thus the poor patient too often wends his way to the operating table because the x-ray found something that did not exist or because the surgeon was convinced that the x-ray had not found something that did exist.

A case of abdominal angina may simulate gall stone colics, even to the point of showing slight but definite jaundice. When angina is known to be present there may often be a doubt as to whether the patient may not also have gall stones. Likewise with known angina there may still linger a suspicion of concurrent gastric or duodenal ulcer or of appendicitis, according to the type of the angina. Considering that these cases are poor operative risks a true diagnosis is especially desirable.

The most characteristic form of the disease is dependent upon exercise. An attack may be induced after any meal by sufficient exertion, but if the patient is quiet no abdominal pain results. The attacks are independent of the character of the food. When the pain begins, rest is the chief requisite for complete relief, but it is a curious fact that the belching of gas may in some true cases be excessive and abruptly terminate an attack.

Although abdominal angina gives no x-ray signs below the diaphragm, it is possible in a proportion of cases to show a dilatation of the aorta, especially of the descending thoracic or a cardiac outline more or less characteristic of aortic valve disease. For enlargement of the heart, the Bardeen method is here of great service.

Out of the extensive literature we may select the account in Lockwood's *Diseases of the Stomach;* Vol. V, of Monographic Medicine; and the Mayo Clinic, Vol. II and Vol. X. The term abdominal angina is not always to be found and the subject may be discussed as the abdominal symptoms of angina pectoris. Lockwood states, "A patient may be suddenly seized by sharp lancinating or crushing paroxysmal pains which recur at short intervals after every fifteen or twenty minutes, and last but a few moments at a time. Slight icterus has been observed at times, suggesting the possibility of biliary colic. A succession of paroxysmal pains constitutes an attack which may last for several days and be followed by a period of comparative freedom. The attacks are often induced by worry or nervous excitement,, and may appear during the night. During the height of pain dyspnea, moderate cyanosis, and Cheyne-Stokes respiration may be present. In a few of the cases a moderate icterus has been observed." Another type of abdominal angina is noted by Lockwood as follows: "A dull aching and throbbing pain may be experienced about one hour after eating, which is not due to gas. As a rule the heartier the meal the greater the distress. It is probable that in these cases the narrowed arteries are able to carry sufficient blood to the stomach for its requirements in the quiescent state, but are unable to meet the increased demands of physiological congestion during the digesting state. During active peristalsis the symptoms of ischemia become apparent and the condition is therefore akin to that of intermittent claudication." Fussell in Monographic Medicine, Vol. V., page 430, states that angina pectoris is to be differentiated from indigestion, gastric ulcer, gall stones and appendicitis. He says further, "Cases of angina pectoris occur which have as their cardinal symptoms pain in the epigastrium after eating and on exertion, the exertion having to be stopped immediately. Relief of this pain accompanied by belching of large amounts of gas are frequently considered both by the laity and by physicians as indigestion."

Such cases, he repeats, "are due to real cardiac disease, and, while they are looked upon often as simple indigestion, they are really cases of angina, and may eventuate in cardiac decompensation or in sudden death." Again he says, Vol. V., page 321, "Angina pectoris is frequently accompanied by pain, having its chief point of severity in or about the gall-bladder region."

Eusterman, Mayo Clinic, Vol. II, page 1918, reports a case of abdominal angina which had been sent in for supposed gall stones. Eusterman's article on abdominal pain contains the only reference to abdominal

angina which I was able to find in the Mayo literature.

As you well know, digestive symptoms and epigastric pain may arise as a reflex from organic disease in the appendix, the gall-bladder or many other organs of the body. But without reflex disturbances of any kind, certain diseases which are roentgenologically silent below the diaphragm may closely simulate organic diseases of the digestive system to the discomforture of the roentgenologist. A study of this group may avoid serious diagnostic errors, fruitless medical treatment and equally futile surgery, and may be of inestimable value to the patient by indicating a regimen for the relief of pain and the prolongation of life.

The roentgenological aspects of this group of diseases giving rise to visceral crises consist:

1. In the value of negative findings.
2. In the necessity of a careful review of the clinical records before drawing roentgenological conclusions.
3. In the value of certain slight inconstant positive roentgen signs.
4. In the necessity of examining the chest for signs of aortic or cardiac disease.

EDITORIAL

The JOURNAL OF RADIOLOGY

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Policy of the Radiological Society

THIS is an opportune time for the members of the Radiological Society to take an inventory of their aims and purposes. The Society has had such a phenomenal growth that the casual observer wonders what made it possible. This growth was not the result of chance, but was due to a definite well thought out plan put into action at the time of the reorganization of the small sectional Western Roentgen Society into the broad Radiological Society of North America. That the men responsible for the reorganization had an altruistic motive impelling them is attested by the popular approval of the organization. The same principles which make for success in a business enterprise govern the success of a scientific organization. Mr. John Siddal, the editor of the American Magazine puts this truth in the following words:

"Ingrowing businesses usually die a painful death. Nature protects herself by a fiat that the self-centered man or the self-centered institution shall surely shrivel up and blow away. On the other hand, the man who thinks first of his customer nearly always succeeds.

"You may think that this is obvious. All business men, you say, instinctively must think first of their customers. But they don't. Many of them are so self-centered that they fail to see the advantage to themselves of forgetting themselves, and looking at things from the point of view of those with whom they deal. The successful man is always smart enough to put himself in his customer's place. He wins out—and then the world calls him a genius."

So long as a similar motive impels the Radiological Society just so long will it succeed. Whenever this motive is lost then failure will surely follow.

Dr. Alden Williams, president of the Radiological Society, 1921, wisely established a far seeing policy. This policy aimed to accomplish the following:

1. To extend the membership to include as nearly as possible all men practicing radiology on the continent of North America.
2. To elevate the practice of radiology:
   (a) by giving the members a clearer understanding of this broad medical specialty.
   (b) by securing the cooperation of other medical organizations.
3. To provide permanent means for publication of the official organ of the Society, the Journal of Radiology.
4. To lay the foundation for a permanent endowment fund for research in radiology.
5. To provide a plan for licensing radiological technicians.

This policy provides work for future years. The officers of the Society, subsequent to 1921, are morally bound to proceed with this policy or be guilty of malfeasance in office.

It has been and still is the aim and purpose of the Journal of Radiology to continue this broad-minded policy and to bring about its realization as far as possible. Sustained activity well directed is the only solution. Editorials of the past year have contained much thought in support of the policy of Dr. Williams. His policy was much wiser than the casual observer might think. He united the College of Physicians, the College of Surgeons and the Radiological Society in cooperative effort to put the practice of radiology on a proper level. His policy, if carried through to its logical conclusion, will do more for the radiologists of the North American Continent than any movement previously inaugurated. Let us quote briefly from the speech of Dr. Franklin H. Martin of the College of Surgeons. This speech was made at the annual meeting of the Radiological Society, December, 1921, when Dr. Williams was president:

"Do you realize that to that mechanical 'too goodness' you should add idealism? That, I know you have or this society in six years could not have grown into the society that it has. No society lives on pure mechanics. No society lives on pure science. It must have an ideal.

"Your president has just given a hint that you have ideals and aspirations. He wonders why the American College of Surgeons in its minimum standard has not required that the roentgenologist in the hospital be a medical man. We did not think that would be necessary, but it is something we are very glad to have suggested, and it will be written in just as soon as public opinion will support it. This organization must realize that it is probably right on the brink of doing work the most important that the medical profession will have to do. You are probably right on the brink of therapeutic work that will mean the control and possibly the curb of malignant diseases. You not only will be the mechanism, the picture maker, the searcher after things, but you will be great therapeutists. *Let me urge this: That you do not remain any longer simply water carriers and wood choppers and assistants, but insist that the roentgenologist be a medical man and insist that he sit in at the consultation.*"

This address committed the College of Surgeons to the policy of Dr. Williams and the Radiological Society. As proof that this action has already borne fruit it is interesting to read the proceedings of the American College of Surgeons as reported at the Hospital Conference, Boston, October 23, 1922. This report is published in Surgery Gynecology and Obstetrics, January, 1923, pp. 149-150; it is headed, "Section D—Roentgenological Service" and is made by William A. LaField, M. D., Bridgeport, Connecticut. The report reads thus (italics our own):

"It has been suggested that our discussion of this subject be limited largely to the extent and supervision of x-ray service in hospitals. Accordingly, our program contains the following questions to guide our discussion:

1. "Hospitals today are asking what should constitute a complete service in an x-ray department. Should all institutions be able to perform fluoroscopic examinations, gastro-intestinal work and treatment?
2. "In many hospitals today the x-ray department is under the management of trained technicians. It is generally stated that interpretation of x-ray plates can only be done successfully by the trained medical man. In such places as cited, interpretation has to be left to the individual physicians referring cases. Is this satisfactory, and can you have an efficient x-ray service in this manner?

"I have great reluctance in coming before you and attempting to give precise answers to some of your problems as to the x-ray laboratory in a small hospital. May I say first a word as to the responsibility of the roentgenologist. In the first place, *the responsibility for the service must be left to a competent roentgenologist who must be a graduate physician well versed in anatomy and physiology; he should be a competent physician*, so that he may study with you the essential data regarding his x-ray findings and give you an intelligent interpretation. He must have a fair working knowledge of radio-physics. He must be a good amateur photographer, something of an electrician, and something of a politician. The technician—the individual who does the routine work of the laboratory—should be a graduate nurse trained by a roentgenologist and should follow a definite routine technique in all roentgen examinations; and she must work under the supervision of an attending roentgenologist. She must confine her activities entirely to x-ray practice. She must work under such supervision that she will realize her limitations and responsbilities.

"With a hospital of perhaps 100 beds or in a community of 25,000 to 50,000, it is not usual to have a man give his entire thought and attention to the practice of roentgenology as a profession. A community as small as that will not adequately support a man doing roentgenology as a specialty. In any hospital measuring up to the standard of the American College of Surgeons there is no reason why this department could not be placed under the intelligent supervision of a roentgenologist who is not necessarily an active member of the hospital staff. He may be a man in a comparatively remote place from the hospital he serves. It seems to me the first plan would be to establish a small department under the immediate supervision of a graduate nurse who has been trained in this work.

"Perhaps we can best bring out the answer to the first question, 'What should constitute a complete service in an x-ray department?' by giving you first the limitation of your roentgen service. There is no doubt in the mind of every man doing extensive work in this line that every hospital should be equipped to do roentgenological examinations of the gastro-intestinal tract, chest, skull, and the urinary tract. Some hospitals leave the entire charge of roentgenology to a technician. Would you rely upon the opinion of an orderly or a nurse for an interpretation of the changes in the renal pelvis? Would you rely upon the opinion of a high school graduate, not a graduate physician, as to the significance of a tuberculous lesion in an extremity? In my mind there is no question as to who should assume the responsibility of x-ray interpretation.

"The interpretation of x-ray plates cannot be left to the various members of the hospital staff. *The relationship of the roentgenologist to the staff is the relation of the consultant to the physician.* If the roentgenological service is to be of any real value in your hospital you must look upon your roentgnologist as a consultant. If the roentgenologist is of the right type his opinion is just as valuable as the opinion of your attending neurologist. In our hospital we do not send a requisition for an x-ray examination; a consultation is arranged and the patient is referred to the x-ray department for consultation. If a medical roentgenologist is in charge of the x-ray department he should be equipped to do roentgen therapy. That is a procedure of such responsibility that it cannot be left to a technician, no matter how well trained.

"I am in a position to judge somewhat of the x-ray needs of a hospital in a small community, and I believe we have solved the problem for one hospital in our state near Bridgeport. A hospital of about 100 beds in a community of 25,000 has a competent graduate nurse in charge of the roentgenological service and the films that are taken there are sent to us for interpretation. A roentgenologist can in the course of two or three months train a graduate nurse in the roentgen examination of the gastro-intestinal tract so that she can produce a series of plates following out a standard technique. A movement has now been instituted by the American Roentgenological Society to standardize x-ray reports. A long time ago routine examinations were standardized as to technique, and the standardization of the report and the individual interpretation of it will mean adequate service for the small hospital.

"*I believe that technicians assuming the responsibility in hospital x-ray service should be examined as to their fitness for the work, be registered, kept within their limitations.*"

Could any language be more forcible? The College of Surgeons has now taken the stand that in all standardized hospitals, at least, the department of roentgenology shall be in charge of "a competent roentgenologist who must be a graduate physician well versed in anatomy and physiology." "He shall be a competent physician." Further, "The relationship of the roentgenologist to the staff is the relation of the consultant to the physician."

It will be recalled by those present at the annual meeting of the Radiological Society, December, 1921, that Dr. Frank Smithies, representing the College of Physicians, made a very pertinent statement, saying that the "American College of Physicians insists that the direction of all laboratories of actinology shall be in the hands of properly licensed, properly educated and practicing physicians." This statement of action already taken by the American College of Physicians is followed by a similar action by the American College of Surgeons, as shown above. These standards are now an accepted policy by the two most representative bodies of physicians in America. Is it any wonder that we point now to the wisdom of Dr. Alden Williams in outlining such a policy.

With so much accomplished in two years, the possibilities of the future are beyond visualization. In order that future growth may be equally satisfactory it is essential that those in authority in the Radiological Society have a clear cut idea of the policy of the Society and that they eliminate all self advancement and selfishness. As Dr. Wasson recently expressed it: "The very fact that a man seeks an office in the society should at once render him unfit for election." The constitution of the Radiological Society, as well as that of any other organization is the law by which that body lives. If the constitution is disregarded the organization is like a ship without her rudder—a wreck is near at hand. Along the same line of thought it might be well to say that when any officer already elected degrades his office by entering into personalities and wilfully making unfounded accusations against other members of the organization, and

even violates the constitution of the society, his resignation should be called for at once.

Dr. W. Warner Watkins in an able editorial in the February issue of the Journal called attention to the need of uniting all medical men interested in radiology. So thoroughly has the writer been convinced of this necessity that not only all possible personal influence has been used, but the fixed policy of the Journal of Radiology has been exerted toward that end.

It will be recalled that in 1920 when Dr. Tyler was called to the presidency of the Society there was a membership of about 200. During his term as president, under the able work of Dr. Alden Williams, then Chairman of the Membership Committee, approximately 200 additional members were added. During the presidency of Dr. Williams in 1921, approximately 200 more members were secured, and during the presidency of Dr. Albert Soiland, 1922, about 200 additional members were elected.

Inquiry into the Society records shows that during the years 1921 and 1922, the applications for membership were secured either because of the prestige of the Journal of Radiology or directly through the Journal organization, the Chairman of the Membership Committee being responsible only for the policy followed. These facts emphasize the value to the Society of an aggressive official organ. and emphasize also the fact that the Journal has at all times used its influence to promote the advancement of the science of radiology, and the Radiological Society.

Dr. Watkins also calls attention to the need of extending the membership so as to include as nearly as possible all radiologists in North America. He estimates the total number at 2,000. It is interesting to note that a survey already made by the Journal of Radiology discloses the fact that there are approximately 10,000 medical men on the North American continent who are eligible to membership in the Radiological Society.

With this information in hand, how dare any one say that the field is now covered and all that is now necessary is to fold our hands and enjoy the fruits of our labors? The history of every successful organization is indisputable evidence of the value of the young man to the society. To rest on past achievements is a sure sign of beginning decay. Dr. Watkins says: "We cannot and must not ignore these new radiologists, since they will be the leaders ten years hence." This means that if the Radiological Society is to remain virile the young men in the profession must make it so by being inside the membership and active in its work.

Numbers alone is not the ultimate goal, but there are vast unfathomed possibilities for advancing the membership of the Radiological Society without sacrificing quality by lowering standards. Once the young man is in the Society he becomes a bigger, broader man and in turn makes the Society bigger and broader.

If the individual on the inside can realize more fully that radiology requires a broad knowledge of medicine it will be that much easier to "bring the general profession to the realization that the interpretation of pathology, and not technical procedure, constitutes the work of the radiologist; that such interpretation requires a high degree of medical knowledge."

It is only necessary for the members and officers of the Radiological Society to continue to cherish the unselfish, altruistic motive as advocated by Dr. Williams and advanced by the Journal of Radiology in order to guarantee the steady growth of the organization. The plan of resting on our laurels, as suggested by some, is no less than suicidal. No matter whether the individual radiologist follows the lode star of altruism or degrades his profession and himself by sacrificing all to selfishness, the same rule holds good. Even the latter type of individual looking at the problem from a purely mercenary standpoint will be much better off if he aids his fellow specialists in every way possible. The work done by them will not curtail the selfish man's income, but on the contrary will bring more work to the community, of which he will get an increasing share.

Erratum, January Issue

IN THE article entitled "Weight Development in White rats as Influenced by X-ray Exposure" and written by Dr. S. Edward Sanderson of Detroit, we regret that the charts appearing therein have attached to them the wrong captions. The captions should have been as follows:

"Figure 1" and caption belongs with Figure 3 on page 14.
"Figure 2" and caption belongs with Figure 1 on page 13.
"Figure 3" and caption belongs with Figure 2 on page 13.

Regarding the caption appearing with Figure 4 the author submits this addition: "The two (rats) to the right were not treated to show weight development, but were accidental anomalies, born deformed. We know that the mother had a treatment three weeks before these animals were born. We do not know that this treatment had anything to do with the deformity of the offspring. We presume it is possible. The two animals to the left graphically illustrate the increase in body weight—so we deduce—secondary to x-ray stimulation, the smaller one above having received no treatment and being a normal rat, whereas the larger lower rat appeared to be the product of stimulative treatment. All animals had been preserved in 10 per cent formalin, which accounts for their disheveled appearance."

French Medical Radiologists

THE SOCIETE de Radiologie Medicale de France announces the following officers for the year 1923:

PRESIDENT

Dr. Ledoux-Lebard....22 Rue Clement-Marot, Paris

VICE-PRESIDENTS

Dr. Barret..............33 Rue de Lisbonne, Paris
Dr. Castex................13 Rue Kleber, Rennes

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Dr. Thoyer-Rozat...........12 Rue Desaix, Paris

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Dr. Belot.............36 Rue de Bellechasse, Paris
Dr. Ledoux-Lebard.....22 Rue Clement-Marot, Paris
Dr. Lenglet................9 Rue Vezelay, Paris

EDITEUR

M. Masson.......120 Boulevard Saint-Germain, Paris

German Congress

THE GERMAN Roentgen Ray Society announces its fourteenth annual meeting, which will be held in Muenchen, April 16, 17 and 18, 1923. Foreign guests are urged to attend, in the general invitation which the society has issued.

The first day will be given over to diagnostic problems, the second day to therapy and research problems, and the last day will be devoted to a discussion of the physics and the technique of x-rays.

Mid Annual Meeting

THE MID-ANNUAL meeting of the Radiological Society of North America will be held in San Francisco, June 22 and 23. The hotel headquarters will be at the Palace, and the meeting will be held in the Civic Auditorium.

Recognition Rendered Roentgenology

THE Roentgen Society in cooperation with the Electro-therapeutics Section of the Royal Society of Medicine held a most successful meeting in Manchester this past autumn.

In an editorial in the *Lancet* of November 25th the writer remarks that two main lines of thought were stimulated in his mind by this meeting. One is of the rapid development and importance of radiology and radiotherapy in the medical world and the second thought is that radiology is developing along novel lines.

He says, "To the radiologist for a long time the fight for recognition has been somewhat of an uphill one. The presence of a number of physicians and surgeons at Manchester at a meeting presided over by Sir Humphrey Rolleston, as President both of the Royal College of Physicians and of the Roentgen Society, shows that general medicine and surgery are arriving at a thoroughly sympathetic attitude towards radiology. Similarly the well equipped demonstration room which is now provided on the initiative of Dr. A. E. Barclay at the Manchester Royal Infirmary, in which all clinical cases can be seen and demonstrated by the staff, should be a big step towards bringing about the needful cooperation. The pure pathologist too is turning with interest to the investigation of the changes which are produced in tissues by physical treatment, and work in the general investigation of cancer and other diseases continually suggests further points of view from which the radiologist can deal with disease."

Professor Salmonson

THhe University of Amsterdam mourns the passing of Prof. J. K. A. Wertheim Salomonson whose death occurred the 16th of last September.

Since 1899 Professor Salomonson had held the position of Professor of Neurology and Radiology at that University and at the time of his death he held the office of Rector Magnificus there.

He was a master in medical and physical knowledge and had a genius for instrumental design, a combination of powers which makes his loss keenly felt in the radiological world at large as well as in the immediate professional and scientific environs of his efforts.

Professor Roentgen

WILHELM Konrad Roentgen, Ph.D., died February 10th, after a very brief illness. His body was cremated at Ostfriedhof Cemetery, Munich, Germany.

Professor Roentgen was born in Prussia in 1845 and in 1869 he received the degree of Ph.D. from the University of Zuerich, Switzerland. Following this he taught at Hohenheim, Strassburg, Giessen and Wuerzburg, where he was director of the physical laboratory.

After his discovery of the x-rays in 1895 he was, in the following year, awarded the Rumford Medal of the Royal Society, London. In 1900 Columbia University awarded him the Barnard Medal, and in 1901 he received the Nobel prize in physics. From 1899 he had been Professor of Experimental Physics at the University of Munich.

CASE REPORTS

Chronic Atrophic Arthritis

C. C. BIRKELO, M. D.
Detroit

CASE 3. We are reporting this case as it shows an unusual degree of atrophy and complete dislocation of several joints. There is also a small amount of hypertrophic change but the main condition is one of bone atrophy.

History: Mr. B., age 31, internal revenue collector, had three attacks of acute articular rheumatism in 1903, 1909 and 1914. During each of these attacks he spent several weeks in bed and at the time of the first attack, he was unable to be on his feet for three months. The rheumatic pains disappeared in all joints except the feet where it persisted until he had proper arch supports made and when these broke down he was unable to be on his feet for more than twenty minutes at a time. His history is otherwise negative and general health is good. No one has ever found any focus of infection as the possible cause of the arthritis disturbance.

No x-ray examination was ever made until the present one. He is now attending to his business and on his feet a considerable portion of the day with a fair degree of comfort.

Bilateral Calcification in the Fallopian Tubes

CASE 4. Mrs. M. G., age 34 married 15 years, has no children and no history of pregnancy. The menstrual history is normal. Family history is negative.

Past History: Patient has had measles and chicken pox but otherwise has always been well until three years ago when she began having dull aching pains over the lumbar region, extending forward to the region of the symphysis. These pains usually came on after prolonged exertion such as washing or similar work, and were often of the nature of colic. After these attacks small amounts of blood and pus would appear in the urine.

Tuberculosis of the right kidney was the clinical diagnosis, and an x-ray of the genito-urinary tract was requested. X-ray examination revealed two small round shadows in the pelvis, one 3 cm. to the left of the median line and the other 4 cm. to the right of the median line and both 7 cm. above the symphysis. These remained in the same position following catharsis and a diagnosis of calculi in the lower ureters on both sides was made.

An operation was then performed, a median incision being made. There were numerous pelvic adhesions and the fimbriated ends of both tubes were involved so that the lumen was closed in each. The calculi described in the x-ray were found, one in each fallopian tube, and removed. The right ureter was found to be about the size of an adult's middle finger, tortuous and tuberculous. The right kidney was not tuberculous.

It appears that all of the symptoms originated in the tuberculous right ureter and that the calculi found in the tube were not the cause of any pain.

*—Cases 1 and 2 reported in January Journal.

Bone Regeneration--A Graphic Story

L. J. CARTER, M. D.
Brandon, Manitoba

Fig. 1.

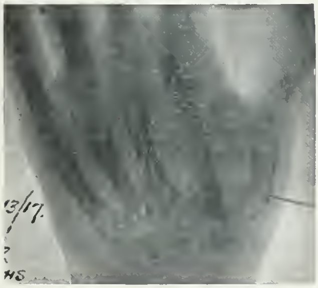

Fig. 2.

Fig. 3.

THE above illustrations exhibit in a graphic way nature's method of restoring a bone after bone grafting. The first shows a bone cyst of the second metacarpal. This was removed and nothing left except a small part of the base and the epiphysis at the head. A transplant from the tibia was inserted.

Four months later (Fig. 2) the transplant is seen apparently uniting with head and base.

Seven months after operation the transplant is taking the characteristic appearance of a normal metacarpal bone with the sites of union rounded off. (Fig 3.) Apparently the transplant has been adopted "holus bolus," and has not simply acted as a bridge and then undergone absorption.

Four and a half years after operation (Fig. 4) the medullary canal has become established, and it is difficult to distinguish the new bone from a normal metacarpal. Function is perfect.

Fig. 4.

DEPARTMENT of TECHNIQUE

An Aluminum Cassette For Use in Pfahler's Method of Examination of Sphenoid Sinuses

JOSEPH ASPRAY, M. D.
Spokane

I HAVE FOUND the vertical method of examination of the posterior ethmoids and anterior portion of the sphenoids very valuable. An aluminum casette to hold film and screens makes the method comparatively easy.

The casette is made of thin aluminum 3/8″ by 2 3/4″ by 5″, the front end being rounded, and the other end is open. A piece of cardboard is made to fit this cassette and protrudes from the open end about an inch.

Before placing the cardboard in the cassette a flap of orange paper is fastened about three and one-half inches from the inside end. We have two intensifying screens, one of which is fastened to the cardboard and the other

to the flap. The duplitized film cut to fit, is placed between the screens and the entire filling is placed in the cassette with cardboard on the bottom. A lead letter "R" is fastened to aluminum top on right.

This cassette, properly loaded, is placed as far back as possible in the mouth, the patient breathing through the mouth. Out of over a hundred cases we have yet failed to see the patient who would not tolerate it.

Have patient lie upon the back on a four inch hard pillow, head straight, with a three inch cone centered so that the edge of the cone is near the head, and on a level with the anterior portion of forehead. The technique used is as follows: 90 degree angle, 4½ inch spark, 25 ma., 2½ to 3 seconds exposure.

Posterior-anterior-oblique Examination of Sphenoid Sinuses

FOR the past year and a half I have been using the following methods in the examination of the sphenoid sinuses, along with the usual lateral and vertical methods.

The patient is placed with forehead on cassette, in the position used when radiographing the frontals. The tube is angled upward ten degrees, a three inch cone is used and this is centered over the foramen magnum. Our technique with double screen is 4½ inch spark, 25 ma. and 5 seconds.

This will throw the sphenoid superimposed upon the frontals, and in the majority of cases shows the sphenoid sharply outlined. The size of each side and the densities can be definitely judged.

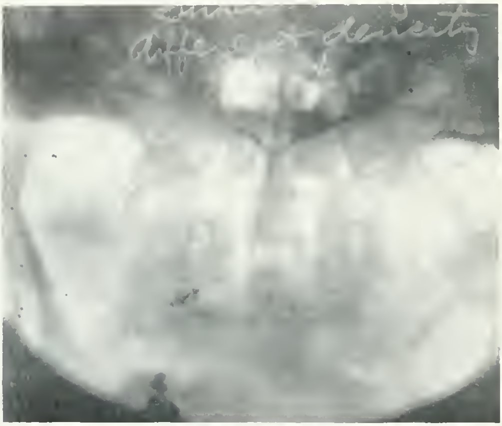

Fig. 1—Sphenoids of different densities.

Fig. 2—One side of sphenoid filled with lead. Lead ring around foramen magnum.

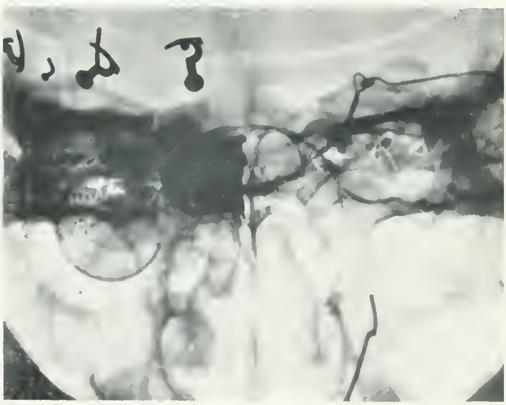

Fig. 3—Left sphenoid filled with lead.

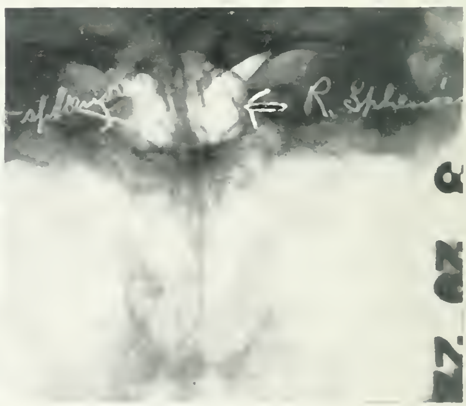

Fig. 4—Right and left sphenoids.

(NOTE—Due to the fact that the illustrations in Dr. Aspray's article were transposed in the February issue, it is reprinted herein.—Editor.)

ABSTRACTS *and* REVIEWS

Foreign Bodies in the Bronchus and Esophagus. Chas. F. Bowen, M.D., Am. J. Roentgenol. 9:709, November, 1922.

PREPAREDNESS is one of the greatest factors for successful operation of these cases. Dr. Bowen describes how in one of his early and difficult cases he rehearsed the most minute details of the operation several times from beginning to end before the real event.

Many times foreign bodies are overlooked because the roentgen plate has not been sufficiently clear. Serious oversights have been known to thus occur. A lateral view should be taken if there is any difficulty about locating the body.

A foreign body in the esophagus can easily be removed by the forceps and fluoroscope if the body is smooth and not imbedded—otherwise the esophagoscope will be necessary and fluoroscopic guidance will aid the operation. The roentgen ray should be at hand ready for instant use for a body may change its location very quickly.

The bronchoscope is required for removal of bodies in the trachea or bronchi and it is just as necessary here that the roentgen ray should be ready to switch on at any instant..

Non-opaque foreign bodies are difficult to diagnose. In the lung an abscess or pneumonic process may furnish a clue, in the esophagus observance of a barium meal or capsule passing through may aid in locating the obstruction.

The New X-ray Department of the Manchester Royal Infirmary. Jour Roentgen Society, 19:22, January, 1923.

UNDER the leadership of Dr. Barclay the Manchester Royal Infirmary has a new x-ray department which is said to be the most completely equipped of its kind in Great Britain.

It is on the ground floor, indirect lighting is used and ventilation is splendid. Aluminum tubing replaces the old high tension wires and most of the x-ray bulbs are contained in boxes covered with lead sheet. The walls are coated with plaster containing a large admixture of barium sulphate which gives a protection equivalent to about 8 mm. of lead. Ceilings are white enameled.

Coolidge tubes and closed-core high tension transformers are used except in the treatment department where the existing induction coils have been brought up to date. The alternating current for the filaments of all the Coolidge tubes is furnished by a central rotary converter. Two separate 200,000 volt outfits each of the twin coil type are in use; one of these is of German make, the other an oil immersed type furnished by Newton and Wright.

Unusually elaborate screening stands and couches are installed. A very interesting feature is that the dark room can be flooded with light and air. Thermostatic control of the developing and fixing fluid is provided.

Other features of the plant are a demonstration room where doctors and students can watch examinations without hampering the work, and a "stereomotograph" which automatically changes lantern slides by pressure upon a button.

"The layout of the department is well nigh a model of its kind."

Radiation Therapy in the Modern Hospital. Henry Schmitz, M.D., F.A.C.S., Mod. Hos. 20:136, February, 1923.

THE writer announces that he is writing from the standpoint of a surgeon and a roentgenologist.

Localized malignant disease should be operated upon if "absolutely confined within the organ or tissue of primary occurrence" but "operations performed on advanced and generalized carcinoma only add to the unbearable misery of these unfortunate beings.*** Instead of relief a multiplicity of symptoms is added."

Cancers that have involved contiguous or distant tissues or organs should be treated by radiation therapy. Generalized carcinoma benefits neither by surgery nor radiation but should be treated symptomatically.

Hospitalization is necessary. The author recommends as preparation that the evacuation of the gastro-intestinal tract be made complete. The patient should be put upon liquid diet and should be given 30 grains of sodium bicarbonate the day before treatment, and each day during treatment and after care. Also the juice of three oranges should be given every four hours and water should be freely given. One half hour before treatment he gives the patient one-half grain of codeine sulphate. Vomiting and diarrhea, if excessive, should be treated by bed rest, large doses of bismuth subnitrate and sodium bicarbonate. Rectal flushings of starch water with tincture of opium are also recommended; if the patient can retain it castor oil is said to accomplish wonders in alleviating the discomfort. Bland foods, sunshine and tonics, especially iron and arsenic, are included in the after care advised.

Transformers of 280 kilovoltage whose output can be increased by connection with additional units in series are recommended in the equipment. Tables and tubestand should be of wood entirely and the patient should be properly protected. Lead wall linings should be three-sixteenths of an inch thick and the observation window should have at least three thicknesses of standard lead glass. Ventilators should be large. The problems of installation will differ in different hospitals.

The chief should in all events be a physician who has proper training and experience in the specialty of radiology.

There are various solutions of the problem of the financial relation of the hospital to the department. The physician may furnish all the equipment (including salaries of workers, repairs, etc.) and simply pay rent, or a percentage of net income to the hospital; the hospital, of course, will profit by the hospital services rendered patients. On the other hand the hospital may assume full responsibility and engage a director to work under hospital management.

The following budget is submitted, given an apparatus with an estimated life duration of five years, a tube with estimated life of 60 to 90 hours and a laboratory having a yearly capacity of 400 patients, actual running time six hours daily:

Sinking Fund	$2,000.00
Tube repairs	2,800.00
Salary (technician)	1,800.00
Incidentals	1,000.00
Total Expense	$7,600.00
Income	$20,000.00
Net profit	12,400.00

Acute Constitutional Symptoms Due to Radiation. Sir Humphrey Rolleston, M.D., Jour. Roentgen Society, 19:5, January, 1923.

THE hypotheses of roentgen ray intoxication are all reviewed in this paper together with a description of the symptoms of this condition. The ob-

servations and experiments of many workers are noted.

The author rather discredits the view that attributes most of the effects to contaminated atmosphere, though he considers that ventilation, careful technique, and dosage, state of the organism, blood count and pressure are all factors to be carefully considered in giving treatment if toxemia is to be held down to the minimum.

Diuresis assists in eliminating the toxic products and sodium bicarbonate both before and after treatment is considered a useful agent. Beck's method of surgical exposure and removal of as much of the growth as possible before radiation is mentioned as a possible aid in treatment.

To sum up the evidence, "It seems probable that the acute constitutional symptoms are due to flooding of the circulation with protein liberated by the destruction of cells."

Animal experimentation with injections of horse serum is now being done and may possibly bring at least a partial solution of this problem.

Protection in Radiology. George E. Pfahler, M.D., Am. J. Roentgenol. 9:803, December, 1922.

THIS article is an expansion of the preliminary report which was published in the October issue of the American Journel of Roentgenology and abstracted in the January, 1923, issue of this Journal, page 27.

The recommendations of the X-ray and Radium Protection Committee of England are given in full in the original article under the following headings: "X-rays for Diagnostic Purposes; X-rays for Superficial Therapy; X-rays for Deep Therapy; X-rays for Industrial and Research Purposes; Electrical Precautions in X-ray Departments; Ventilation of X-ray Departments; Radium Therapy."

General recommendations of this committee are as follows: "It is the duty of those in charge of x-ray and radium departments to ensure efficient protection and suitable working conditions for the personnel. The following precautions are recommended: (1) Not more than seven working hours a day. (2) Sundays and two half-days off duty each week, to be spent as much as possible out of doors. (3) An annual holiday of one month of two separate fortnights. (4) Sisters and nurses, employed as whole-time workers in x-ray and radium departments, should not be called upon for any other hospital service."

Dr. Pfahler recommends that the American Radium Society appoint a committee known as the Committee for Protection in Radiology, to cooperate with the Safety Committee of the American Roentgen Ray Society, together to formulate certain problems to be worked out by the Bureau of Standards at Washington, D. C.

He discusses briefly the protection of the patient, and the protection of the radiologist against loss and against unjust claims. The present loose system which allows men to practice radiology without proper preparation does much to bring the specialty into disrepute, for many legal claims arise from the mistakes of unqualified workers and the public does not discriminate. This state of affairs can and should be remedied.

Radiology: Its Use and Abuse. Reginald A. Morrell, M.R.C.S., Eng., L.R.C.P., London. The Lancet, 203:748, October 7, 1922.

THIS paper written for the senior medical students of Sheffield University leads to a high mountain top whence one may view the science of radiology in its relation to the rest of the medical world—but its dangers and pitfalls are portrayed along with its glories. It is all old news to the practicing radiologist but to the uninitiated student, who may not have attained an intelligent picture of the specialty, it is most enlightening; facts are presented in a telling manner, and furthermore it is written in such English as delights the ear and gratifies the mind appreciative of such things.

The Diagnosis and Treatment of Bone Lesions: A Brief Summary of the Salient Features. Joseph Colt Bloodgood, M.D., Am. J. Roentgenol. 10:42, January, 1923.

IN A CASE of known fracture x-ray examination is now a matter of routine but it has not yet become so in cases of contusion or bruise where the fracture is not at all apparent. Nevertheless it is in just these cases that it is, in the light of present knowledge, a very necessary procedure. Discovery of an incomplete fracture may thus be made, but far more important than this are the facts that preexisting osseous lesions are frequently thus revealed and that the x-ray picture of the bone at time of the injury is very valuable if later on there develops either a benign or malignant pathological process.

The author suggests several ways by which roentgenologists may improve their diagnostic acumen. One of these is by palpation, of which, in connection with roentgenologic diagnosis, the author says he is just beginning to learn the value. Also he believes that no diagnosis should be rendered by the roentgenologist until he has been made acquainted with all the clinical and laboratory findings in the case. To make a diagnosis from an x-ray plate alone is a great mistake. "In every patient with a lesion of bone there should be a Wassermann test, a complete blood examination, an examination of the urine for Bence-Jones bodies and a search for foci of infection in the tonsils, naso-pharynx, teeth and in the genito-urinary tract."

Complete records with a follow up system should be kept for their value to research if for nothing else, and all concerned can aid in this advancement of knowledge.

The Roentgen Ray in Diagnosis of Scoliosis. Frank W. Lamb, M.D., Am. J. Roentgenol. 9:723, November, 1922.

TRUE scoliosis and not the functional or habitual type which results from normal physiological posture is the subject of this paper.

True scoliosis is "a fixed deformity of the spine, characterized by a lateral bending of the column, with structural changes in the parts entering into it, together with a rotation of the bodies of the vertebrae on their vertical axes. The rotation of the bodies is always toward the convexity of the curve with the greatest amount of rotation at its apex."

The normal spine can assume the physiologic scoliotic position right or left, but in scoliosis, while the straight position may be more or less easily assumed, motion to the normal physiologic position opposed to the deformity is not possible.

The old positions and methods used for diagnosis of this condition are often misleading. "It is only by bending the spine laterally and twisting the vertebrae at the same time into opposed positions that the deformity of scoliosis can be determined. * * * In making an x-ray diagnosis of scoliosis the extreme right and left scoliotic positions must be used."

An easily constructed apparatus for holding the patient in position is described.

The Roentgen Diagnosis of Bone Tumors. H. M. Stewart, M.D., Pennsylvania J. Roentgenol. 4:11, October, 1922.

THE significance of the leading points (age, sex, location) which are used as guides in the diagnosis of bone tumors are sketched with particular reference given to characteristic x-ray findings in various tumors.

The author, citing Ewing as an authority, says that to designate bone tumors as round spindle or giant cell tumors in quite indefinite from the pathologist's standpoint, for all malignant

tumors may show these types at one time or another. Whether the tumor is malignant or not is the main point to be discovered and it is of advantage, if possible, to state the predominating cellular growth of the tumor.

Sarcoma (?) of Thigh, with Secondary Sarcoma (?) of Inguinal Region, Liver and Lungs. Recovery After Intensive Deep Roentgen Irradiation. J. Henry Schroeder, M.D., J.A.M.A. 80:23, January 6, 1923.

THIS article reports a case of sarcoma (?) of the thigh with secondary sarcoma of both lungs. Clinical diagnosis of sarcoma of the thigh had been made repeatedly in this case by competent surgeons and amputation had been advised.

Roentgen treatment consisted of ultra hard rays at 220,000 volts, and at 200,000 volts for the lungs, which received 70 per cent and the other areas 80 per cent of the surface erythema dose. From January 21 to February 1 the thigh, inguinal region and both lungs were irradiated, each region received the full dose in one sitting.

The author considers that this case proves that widely disseminated sarcoma is not a bar to successful treatment with roentgen ray irradiations.

Radiotherapy. J. D. Southard, M.D., Fort Smith, Arkansas. From reprint of a paper read before the Sebastian County Medical Society, Ark., October 10, 1922.

THE author of this paper particularly recommends x-ray therapy of bone tuberculosis and reports thirteen cases so treated and eleven cured (one year duration October, 1922).

Five of the cases involved the bones of the spine and one case each of the femur and hip joint, foot and ankle, hand, os ilii, humerus, knee and sternum. "In three of these cases, those of the foot, ilium and humerus, as shown by radiographs, there had resulted considerable bone destruction, causing large defects in the bones, all of which were completely repaired and the defects filled up by bone regeneration during treatment."

Decided success is also reported in the treatment of acne vulgaris.

General Principles of the Treatment of Skin Diseases. Roy Blosser, M.D., Rhode Island M. J. 5:352, December, 1922.

THE etiology of a dermatosis may be bacterial or metabolic in its nature or it may be due to food sensitization. Those dermatoses due to internal disorders, however, should be relieved by local treatment which can often be done, and at the same time the primary disorder be treated.

Roentgen ray is mentioned as useful in seborrhoeic warts, acne vulgaris, chronic eczema, eczematous ringworm and psoriasis.

X-rays in Diseases of the Skin. E. W. Reed, M.D., Brit. M. J. 2:559, Sept. 23, 1922.

TEXT BOOKS on dermatology do not as yet recommend x-ray treatment, except in stinted terms, but the value of x-ray in dermatoses deserves to be better known for often roentgenotherapy offers the best means of cure and succeeds when other measures fail.

The medical man knows too little of skin disease as a rule, but he should at least be able to distinguish the difference between an acute and a chronic inflammation. He should collaborate with a dermatologist when necessary.

The radiologist should also collaborate with the dermatologist but of course should regulate the dosage administered and should see to it that no metallic treatment is given at the time that roentgenotherapy is being used. Many serious complications can arise if this point is neglected.

Contra-indications to x-ray are grave blood diseases and those of blood vessel walls, acute inflammatory conditions of the skin and hemorrhagic skin troubles.

Remembering the contra-indications the rays will be found useful in cases of induration or thickening of the skin, itching, chronic infiltration, lichenification, in conditions requiring depilation and in new growths. All of these conditions are discussed in their clinical aspect.

Little is given of the technique but the author says that he uses a medium soft tube and states that he gradually increases filtration from 0.0 to 0.5 mm. Al to 2 mm. Al and back to 0.0.

The Roentgen Ray Treatment of Acne Vulgaris. Rudolph Jacoby, M.D., Boston M. & S. J. 187:793, November 30, 1922.

IN THE early history of x-ray therapy serious complications and sequalae followed x-ray treatment, but today in the hands of a careful operator who follows modern technique with modern apparatus x-ray treatment is perfectly safe and is the best method in many cases.

However, it is not necessary or wise to treat every case of acne vulgaris with x-ray for hygienic and medical measures are sufficient in many cases.

Three to four months are usually required for a roentgenographic cure providing the patient receives and follows proper advice and treatment and co-operates with the physician. The percentage of cures is about 90 and only about six per cent of this 90 per cent suffer a relapse.

"A standardized apparatus consisting of an interrupterless transformer, rheostat control, standard Coolidge tube, Coolidge transformer and control, and a milliameter must be used. The dosage is measured in skin units." Experimentation has proved that "a three inch spark gap and three milliamperes of current given for four minutes at an eight inch distance delivered the amount of ray corresponding to four Holzknecht units." These four units correspond to one skin unit which is a suberythema or epilating dose. Fractional doses of one-quarter skin unit (one Holzknect unit) are given weekly for from ten to sixteen treatments, even though all symptoms disappear after the first few treatments. Occasionally one will find a patient who cannot tolerate this dose, but not often. Caution and good judgment are requisite to give these treatments, as is true with any radiotherapeutic method.

Ultraviolet Energy in the Therapy of X-ray Dermatoses. A. J. Pacini, M.D., Am. J. Electroth. & Radiol. 11:363, November, 1922.

THE author's summary of his article is as follows: "Ultraviolet energy may be used as a preventive against the erythema produced under x-ray exposure. Ultraviolet energy through its cellular regenerative force, will assist in the reconstruction of indolent x-ray ulcers. In the treatment of acute and chronic x-ray and radium dermatitis the biotic qualities of the air cooled and the abiotic qualities of the water cooled equipment should be clearly and judiciously employed if best results are to be achieved. It is neither proved nor disproved that the application of ultraviolet energy, before or after x-ray exposure, will prevent the damage to cellular structures in depths greater than 75 or 100 microns. Aborting x-ray erythema through the use of ultraviolet energy must not be considered a corrective for the deeper tissue changes induced by the x-ray and radium trauma. Air cooled or biotic ultraviolet energy is useful in every form of acute x-ray dermatitis, and in raising tissue resistance in chronic x-ray dermatitis. Water cooled or abiotic ultraviolet energy, owing to its desquamative capacity, does much to relieve the prominent acanthosis that forms an inherent part of the chronic x-ray and radium skin changes."

The Bactericidal Action of Ultraviolet Light. S. Bayne-Jones, M.D., *and* J. S. Van der Linger, Ph.D., Bull.

Johns Hopkins Hosp. 36:11, January, 1923.

AUTHOR'S SUMMARY

"THIS paper describes methods by which exact determinations may be made of the wave lengths of light which kill bacteria. The sparks of various metals were used as sources of ultraviolet light, except in a few experiments when it was necessary to take advantage of sunlight because of its greater intensity. In most of the work, a quartz spectrograph was used. The absorption spectrum of a bacterial emulsion was correlated with the limits of the bactericidal action of light. The effect of temperature and the influence of hydrogen ion concentration upon the limits and velocity of the germicidal action of ultraviolet light were determined. From the results of these experiments the following conclusions are drawn:

1. "The bactericidal action of light is confined to the ultraviolet region of the spectrum beginning at 350 $\mu\mu$ and extending with increasing intensity to the shortest wave lengths measurable with a quartz spectrograph: 185.6 $\mu\mu$.

2. "These limits coincide with the absorption of ultraviolet light by bacteria.

3. "The temperature coefficient for the bactericidal action of light was found to be 1.05 over a range of 10° centigrade, and the constant in the formula of Arrhenius was 934 to 975.

4. "An increase in hydrogen ion concentration of the fluid in which bacteria are suspended during their exposure to ultraviolet light increased the velocity of the bactericidal action. The accelerating effect began at 4.6, hydrogen ion concentration, the isoelectric point, and was very strong in fluids more acid than this.

5. "Neither temperature nor the hydrogen-ion concentration rendered bacteria sensitive to the longer wave lengths of light."

The Effect of Radiation with the Mercury Vapour Quartz Lamp. E. Margaret Hume. The Lancet 203: 1318, December 23, 1922.

THESE rats were fed a diet deficient in vitamin A. The general conclusion drawn is that irradiation under these circumstances prolongs normal growth and the "amount of normal growth produced as a result would appear to be roughly inversely proportional to the length of time any individual rat has previously been on the vitamin A deficient diet."

The Effect of Radiation with the Mercury Vapour Quartz Lamp. H. Goldblatt, M.D., *and* K. M. Soames, M.Sc. The Lancet 203: 1321, December 23, 1922.

THIS in an account of experimentation upon rats fed a diet deficient in the fat-soluble, growth-promoting factor. It is a preliminary study which so far leads to the conclusion that "radiation with the mercury-vapour quartz lamp cannot act as a substitute for the fat-soluble, growth-producing factor which is a necessary element of the diet."

Are We Positive in Our Diagnostic Solutions of Our Radiograms and Are We Conscientious with Our Patients? J. Callaway Houchins, D.D.S. Dental Facts 10:88, December, 1922.

IN THIS paper the author severely censures the many members of his profession who "merely commercialize with the x-ray." He says it is appalling to know the number of dentists using x-ray machines and reading their own films who can recognize only the grossest pathology such as poor root canal work, broken roots, etc.

If dentists are to have the respect of the medical profession they must prove themselves worthy of it. He says that "only perseverence, honesty and conscientiousness can bring our profession to its greatest possibilities."

A Few Thoughts on X-rays. George Parker, L.D.S., England. Dental Facts, 10:90, December, 1922.

LOOKING to the future the author expresses the hope that "the dental physician" will have recognized authority in all pathological conditions in and around the mouth. He will have a knowledge of dental surgery, but greater still will be his knowledge of those subjects which must be intelligently understood in order that radiographs may be read correctly.

"Those who nowadays are making the x-ray one of the most abused fads deserve every censure, for, by their conduct, they will bring radiography into ill-repute, and from the housetops it may be proclaimed that a radiologist is a delusion and a fraud, and the result will be that the x-ray machine will be cast aside—mere lumber for the store room. * * *

"Experience and intelligence of the operator, backed up by an intimate knowledge of the radiographic appearances of normal and abnormal conditions and the changes that these conditions may produce in the parts under observation are absolutely essential for a correct interpretation. * * * Let us be candid over our mistakes; that is one of the best ways of learning."

Roentgen Therapy in Dentistry. John L. Garretson, D. D. S., Am. J. Roentgenol. 9:740, November, 1922.

INFILTRATION of the lymphatic tissue of the peridental membrane and the gums is the greatest factor in recurrent infections from pyorrhea. If metabolic conditions are at low ebb the tissues may be unable to throw off the infection and it becomes deeply rooted.

The author has found that if these lymphatic areas are treated by x-ray that absorption takes place and that pressure is relieved and the tissues recover. However, he is very emphatic in his warning that no dentist, unless thoroughly familiar with the vital factors concerned in x-ray practice, should attempt this treatment.

The technique which he employs is based upon the mathematicla formulae outlined by Witherbee and has been fully described in the *Dental Cosmas* of November, 1921.

Swelling from jaw infections, pain and soreness of parts, as well as neuritis of long standing, have apparently been greatly influenced by this form of therapy.

Remarks on Hodgkin's Disease. James Galloway, K.B.E., C.B., M.D., London. Brit. M. J. 2: 1201, December 23, 1922.

THE late Sir James Galloway previous to his death was preparing a lecture upon the subject of Hodgkin's disease the notes of which, after his death, were embodied in the article cited above and here reviewed.

The fever and the cutaneous signs of Hodgkin's disease are discussed in separate sections of the paper and treatment is discussed in the last section.

As to treatment he says, "There is still too much truth in the opinion that there is no recorded case of cure or recovery. There are, however, methods of alleviation." These he states are medication by arsenic or treatment by the x-rays which he credits with having "brought about a great improvement in the symptoms and much comfort to the patient."

X-ray Treatment of Thyrotoxicosis. I. S. Trostler, M.D., Illinois M.J., 43:64, Jan., 1923.

TYPES, tests, and treatment are described here. The author favors x-ray therapy for the following reasons: No harm can result, while many cures are wrought and many other cases are relieved; there is no operative risk, no loss of time, no scar, and no nervous strain such as operation involves.

The effect produced by x-ray treatment is like the one produced by ligating the arteries, only it is minus the

complications of that procedure. Besides this effect upon the blood vessels raying produces a sedative action upon the gland cells.

Treatment of the thymic area is considered essential in all cases of Basedow's disease. Rest, medication, and hygienic measures must all be used in connection with radiation.

Toxic goiter is "a disease of increased basal metabolism." The basal metabolic rate is more constant than temperature, pulse or respiration and is a more trustworthy index of changed or deranged function.

The Roentgen Diagnosis of Mastoid Disease. F. L. Schumacher, M.D., Pennsylvania J. Roentgenol. 4:8, October, 1922.

THE various types of mastoids are here described. The author classifies them thus: (1) *Non-cellular:* (a) undeveloped or infantile, (b) diploetic, (c) sclerotic. (2) *Cellular or pneumatic:* (a) small celled, (b) large celled, (c) mixed celled; this second division Cheatle classifies as (a) pure pneumatic, (b) mixed pneumatic and infantile with the pneumatic structure predominating, (c) the double-decked.

These various types are all described in detail too profuse to abstract, but very valuable in the original.

Benign Neoplasms of the Larynx. John A. Cavanaugh, M.D., Illinois M. J., 43:59, January, 1923.

THE lack of painstaking care in laryngeal examinations is amazing, according to this author. The indirect method of examination, while it requires patience, is a simpler, easier and better method of examination than is the direct method.

The etiology, symptoms and treatment of the various types of benign laryngeal neoplasms are discussed.

Regarding radiotherapy he says, "Radium has had its trial with pros and cons, and like all new methods must have its disappointments as well as its successes, for time alone can prove its usefulness. * * * The use of x-ray treatment in this condition has been disappointing, but the new high voltage x-ray may prove beneficial." He warns against its use by those ignorant of its physical laws.

Estimation of Cardiac Volume by Roentgenology. C. R. Bardeen, M. D., Am. J. Roentgenol, 9:823, December, 1922.

IN THE diagnosis and treatment of cardiac conditions the x-ray offers valuable service in the estimation of size and in the study of the effects of drugs, rest and exercise upon the heart.

There is a value in the knowledge of cardiac volume and the more accurate the method of determining heart volume the more valuable does this knowledge become.

That volume can be accurately determined by the usual comparative methods, or that a relative size can be determined by apex beats is disputed and refuted by this author. Roentgenology does offer the needed accurate and reliable means of ascertaining the size of the heart in the living subject.

As to particular x-ray methods of obtaining this and other information the fluoroscope and orthodiascope are invaluable for various purposes, but the teleroentgenogram is to be preferred for estimation of heart size.

The requirements of distance, position, and exposure are given and very complete directions are then given for accurate determination of size from the shadow obtained.

The Roentgenological Study of the Pathological Gall-Bladder. B. R. Kirklin, M.D., Am. J. Roentgenol, 9:713, November, 1922.

TO SEARCH merely for gall stones instead of direct or indirect evidence of gall-bladder pathology is to neglect one's full duty in an abdominal case. A half-hearted, doubting search for pathology will not be thorough and, hence, will often pass over important evidence.

A gall-bladder shadow is indicative of pathology, which may be with or without stones, for a normal gall-bladder casts no shadow. Other symptoms are pressure upon the duodenum or upon the antrum of the stomach, or displacement of the jejunum or colon, or there may be deformity due to adhesions.

Gall-bladders palpated at operation and pronounced normal by the surgeon have been known to show pathology when, upon the strength of x-ray evidence, they have been opened.

The author describes his technique and especially emphasizes the importance of absolute stillness on the part of the patient, as this is necessary to secure the wealth of detail of soft structures necessary for diagnosis.

Ulcer of the Stomach and Duodenum. Dudley Roberts, M.D., J.A.M.A., 79:2226, Dec. 30, 1922.

THIS paper discusses the dependability of roentgen ray and symptom diagnosis of ulcer, the prognosis of ulcers from the roentgenologic standpoint, the results of medical and surgical treatment of ulcer from the roentgen ray standpoint, and the paper is thus summarized:

"The frequency of peptic ulcer has been greatly under estimated, and the relative danger of the lesion greatly exaggerated, because only the more severe and complicated cases have come under observation or have been recognized through clinical study.

"Until we know more definitely the cause of the lesion and the reasons for its stubborn persistence, we can hardly hope for a specific cure and a satisfactory routine for the handling of these cases.

"Meanwhile, treatment must be individualized on the basis of site and the character of the lesion as shown by roentgen ray study; the subsequently demonstrated change in the lesion; the amount of disability; and the presence of complications such as hemorrhage, perforation and stenosis. But, in addition to all these considerations, in reaching a decisions as to a plan of treatment, we must give due regard to the life expectancy in the individual patient, and the economic necessity for absolute rather than temporary symptomatic cure, which is the frequent limit of medical therapy.

The Treatment of Malignancy by Radiation. W. W. Wasson, M.D., Colorado Med., 19:257, December, 1922.

THE process of x-ray and radium therapy from its beginning is here sketched and the known factors in general radiotherapy are explained in a very simple and logical manner, without over-enthusiasm, but with staunch support of what the author's experience has taught him is true.

Multiplex Pathology and the Cancer Problem. William Seaman Bainbridge, M.D., Illinois M. J., 43:20, January, 1923.

THIS review of the history of our pathological knowledge of cancer covers the main outlines of that history from 200 B. C. to 1922 A. D.

In spite of the many discouraging aspects of the present situation as regards the cancer combat the author looks to the future with optimism.

New Light on Gastric Peristalsis. Walter C. Alvarez, M. D., Am. J. Roentgenol, 10:31, January, 1923.

FIFTY years ago heart murmurs were about the only sign by which heart pathology was recognized. Today tremendous advance has been made in knowledge of heart movements and volumes have been written upon the subject. But the knowledge of gastric peristalsis ends today where that of the heart stood fifty years ago. "Gastroentgenologists have gone on simply looking at the stomach." Until they begin to study the delicate movements of the stomach no further advance in

knowledge will be made by them, in the opinion of this writer, but the great technical difficulties in the way of such study will have to be overcome by the introduction of specialized apparatus before much can be accomplished. The author has one such piece of apparatus upon which he has been working since 1914. The results of his work he sums up in the following summary to his article:

"Gastric physiology is far behind cardiac physiology today, because it has remained very largely in the crude stage of dependence upon unaided visual observation. Methods are now being devised for obtaining multiple and simultaneous mechanical and electrical records of the activities of the stomach and bowel. A few records have been obtained of the human electrogastrogram. The electrograms from the digestive tract look very much like the corresponding mechanogram. New evidence has been obtained as to the location and behavior of the gastric pacemaker. Stomach blocks and dissociations have been observed. Cole's discovery of gastric systoles has been confirmed. Several types of peristalsis are described, and some contractions are shown which might perhaps be called, by analogy, pyloric extra-systoles. Two or three different types of contraction can take place simultaneously in one segment of the stomach much as they do in one segment of the bowel. There is a close relation between the activities of the pyloric end of the stomach and the duodenum. It is hoped that the new studies will eventually help the physician and the roentgenologist to recognize and interpret symptom-complexes, much as the polygraph and the string galvanometer have helped the heart specialist to recognize the auricular fibrillation or heart block from the history, or from the feel of the pulse."

Intestinal Reaction to Erythema Dose. Charles L. Martin, M. D., *and* Fred T. Rogers, Ph.D., Am. J. Roentgenol, 10:11, January, 1923.

THE experimental work here recounted was done upon dogs. Loops of the intestine were laid out upon the outside abdominal wall and the viscera thus exposed rayed with a 5-inch parallel gap, target skin distance 10 inches, 10 ma. of secondary current, and with no filter except a thick piece of paper. The abdominal wall and the intestine thus received the same quantity of rays. The wounds were then closed and observations were carried out which lead to the following conclusions by the authors:

"(1) The skin of the dog is much more resistant to roentgen rays than is the skin of man. (2) The minimum erythema dose for the dog's skin when applied directly to the dog's intestine produces hyperemia, marked contraction in all directions and destruction and desquamation of the mucosa. (3) Bloody diarrhea, ulceration, perforation, and stenoses occurring in patients subjected to ultra deep therapy for abdominal tumors may be due to direct intestinal injury. (4) Roentgen cachexia is possibly due to the same cause. (5) Intestinal damage in dogs, resulting from direct radiation, does not always produce an early death."

Newer Investigations of the Problem of Roentgen Ray Dosage. Otto Glasser, Ph.D., Am. J. Roentgenol, 10:1, January, 1923.

THIS paper and one by Friedrich which immediately follows it constitute a general discussion of the problem of roentgen ray dosage combined with a report of the investigations of Friedrich and the author.

The problems of absolute dosage and of practical dosage are specifically discussed by Dr. Glasser in this paper. Friedrich's method of measuring dosage is described and contrasted with that of Holthusen and apparently different conclusions have been reached by the same men, differences which are only apparent, however, as the following discussion will show. Dr. Glasser says: "To sum up: It is evident that in the construction of biological rules determined by small ionization chamber measurements, it is necessary to make certain corrections, whether the ion theory or the energy theory is employed.

"As a matter of fact, series of such biological rules are in existence, on the one hand, from the ionization standpoint, and on the other, from the energy standpoint; the first group is fairly represented by Kroenig and Friedrich, and the second by Holthusen."

Holthusen came to the conclusion "that the biological effect was independent of the wave length over a definite scale of wave lengths, when he applied a definite correction factor, and by this means calculated the ionization currents in terms of energy. In contrast to this, there was a distinct difference in biological effect, when measured by the ionization current alone. Kroenig and Friedrich used large test objects and dosed by the ionization current measurements. It is evident * * * from our investigations that the additional effect of the scattered radiation approximately equals the correction factors employed by Holthusen for estimating the energy of the secondary beta rays. As a result of this, the direct readings by Kroenig and Friedrich automatically supply the right correction, and the applied dose is the same as by the energy theory."

Thus, the apparent and much discussed discrepancy between the conclusions as to biological effects reached by these two groups of workers is seen to be explained by the scattered radiation.

Ionization Measurements. Gioacchino Failla, E.E., Am. J. Roentgenol, 10:48, January, 1923.

"IONIZATION measurements of radiation for therapeutic purposes are reliable, provided the quality of the radiation and the distribution of the ionization in the chamber are not very different for the different measurements. The instrument should be properly designed and constructed as regards the type of ionization chamber, insulation, electrical shielding, screening from extraneous radiation and saturation. It should be calibrated every day, or oftener if a change is suspected, by means of a radium standard."

The Problem of Ray Dosage. Prof. W. Friedrich. Am. J. Roentgenol, 10:6, January, 1923.

THIS is a discussion of the physical factors involved in dosage. The theory of dosage is the first topic discussed, followed by a discussion of scattered radiation, the general problem of dosage, practical (relative) dosage, and apparatus.

Physicist, chemist and biologist must cooperate to build the foundation for the solution of the problem of absolute dosage. The physicist has done his part for the present in the solution of the problem of practical dosage and its further solution depends upon the clinical investigator.

For practical dosage sensitive and reliable apparatus is requisite and the various apparatus for ionization measurement are discussed from the standpoint of physics. "The construction of the ionization apparatus has reached such a degree of simplicity that it may be completely used by those who are not physicists."

Discussion on X-ray Treatment of Deep-Seated Cancers with Special Reference to Erlangen Methods: (I.) J. R. Riddell, F.R.F.P.S., Glas., L.R.C.P., L.R.C.S., Edin.; (II.) J. H. Douglas Webster, M.D., Edin., Ch.B., M.R.C.P., Edin.; (III.) F. Hernaman Johnson, M.D., Aberd., Brit. M. J., 2:506-510, September 16, 1922.

DR. RIDDELL says that the essential differences between the Erlangen method and the older method are that the object of the Erlangen method is "to attain homegeneity in the rays

used, to administer an equal dose to all disease tissues and to do so at one sitting."

The U.S.D. (unit-skin-dose of Seitz and Wintz) is that quantity of radiation which will produce a faint redness of the skin one week after treatment and a faint tanning one month after treatment. The "castration dose" is 34 per cent of the U.S.D.; the sarcoma dose is 70 per cent; the tuberculosis dose is 50 per cent; the carcinoma dose 110 per cent; 135 per cent of the U.S.D. will damage normal bowel tissue and 180 per cent will damage normal muscle tissue.

The technique of treatment with these dosages is described, as is the technique whereby homogeneity of rays is attained.

A number of cases treated by the author during the period from June, 1921, to May, 1922, are described with the present results tabulated. The author considers that the immediate effects are striking and he is hopeful of the future of this method.

Dr. Webster discusses the problem from the physical, biological and clinical standpoints. He says that there is too little comprehension of the fact that types of cancer differ greatly from each other. "To the histiologist it is almost as unilluminating to talk of 'deep-seated cancers' as a group as to talk to an ethnologist of 'Asiatics'; the types of cancer differ much more from one another than, say, the Sikhs and the Malays! Ewing says, 'It may be safely said that there are more distinct clinical and pathological entities within the groups of neoplasms than exist outside of them.' "

He goes on to say that, "Pathologists are naturally sceptical when terms like 'cancer dose' are used without qualification; 'carcinoma dose' may be used as applying to superficial malignancy, certain gynecological primary growths, and to mammary secondary deposits * * * but to apply the term 'lethal dose' to other conditions such as gastro-intestinal carcinoma or primary breast tumors as a whole is an unwarranted reasoning from the particular to the general.'

He says that he cannot dispute the clinical findings as to the benefit of preliminary ionization with copper selenate (used at Erlangen) but he disagrees with the theory of it, basing his opinion chiefly upon Dr. Turrells experiments which have shown that "the blood and tissue fluids rapidly disperse any inflowing ions."

Radiation from a great distance (up to a metre) he would abandon and prefers the interposition of paraffin or water.

Scaled sectional drawings constitute the only accurate method of orienting fields and perfect accuracy is not always obtainable by any means, as the biological factors involved elude physical powers of measurement. The typical Erlangen technique "applies only to stout Bavarian patients."

The interval between doses must depend upon the type and speed of growth and also upon the general condition of the patient.

"The whole subject is thus seen to be one in which as yet sure conclusions are hard to find." However, he praises results already accomplished and is far from sceptical of the future.

Dr. Hernaman-Johnson says that three factors—direct effect of x-rays upon malignant cells, the reaction of normal surrounding tissue and the general constitutional response of the patient determine what the results of the treatment will be in any case.

The doctrine of the "single lethal dose" is flouted by him. He says, "One hears of precautionary doses after six weeks and of yet further 'precautions' at later dates. But if repetitions every six weeks why not every six days?"

The doctrine of the "small stimulating dose" he also flouts. He himself has patients with inoperable or recurrent breast cancer who have received treatment with a voltage limited to 160,000 and who are "going about their affairs five years now after the original occurrence." The effect upon the blood and the general resistance of the patient has kept him from using the single massive dose in any case of carcinoma of the breast.

"The last thing I want to suggest is that the x-ray treatment of breast cases should be undertaken by amateurs or that research should not vigorously be prosecuted. But when a man has been getting good results for years with an ordinary outfit in a hospital which is not able to afford a high voltage apparataus, he should not be frightened into giving up because of the doctrine of the stimulating dose."

He regards the results of the Erlangen method as excellent and believes it is full of promise but he gives full credit to methods long in use in England.

Choice of Combinations of Physical Forces in the Treatment of Cancer. G. Betton Massey, M.D. Am. J. Electroth. & Radiol. 11:352, November, 1922.

"RADIUM should be regarded as a local, destructive agency in cancer only, and for this purpose as inferior to immediate electrochemical or electrothermic destruction when the latter is possible or safe. Complete and immediate local destruction of a cancer is preferable to slow, irritative methods of destruction since the latter open up the avenues of internal invasion, and invite increased growth of any remnants of the local cancer during the wound healing reaction. The x-ray remains the best remedy for internal cancer that cannot be removed by the knife."

Salivary Glands in Carcinoma. L. S. Dudgeon, C. M. G., C. B. E., F.R.C.P., The Lancet 203:558, September 2, 1922.

A STUDY of the condition of the sublinqual and submaxillary salivary glands in carcinoma of the tongue and the floor of the mouth is here presented. Seventy-eight cases were studied in which both the primary growth and salivary and lymphatic glands were examined microscopically. These cases were grouped clinically into (1) early cases with the tongue still mobile and the infiltration slight; (2) carcinoma of the floor of the mouth and late cases of carcinoma of the tongue with the latter fixed and muscles extensively infiltrated; (3) cases of carcinoma of the lip.

The author concludes thus: "In the vast majority of cases of carcinoma of the tongue and the floor of the mouth the salivary glands are not the seat of carcinoma. * * * In nearly all cases the changes present in these glands are of a chronic inflammatory nature, somewhat analogous to the changes met with in the pancreas in chronic pancreatitis, and apparently due to infection from the mouth along the ducts. In other cases no microscopic change can be seen. * * * The lymph nodes in this area show malignant changes in only 27.3 per cent of early and 50 per cent of late cases, though inflammation is always present. It would appear therefore in certain cases with early carcinoma of tongue to be justifiable to leave the submaxillary area untouched at operation, though clinical experience teaches that the risk of the subsequent appearances of metastases is very great."

Carcinoma of the Lip and Cheek. George Emerson Brewer, M.D., F.A.C.S., Surg. Gynec. & Obst. 36:169, February, 1923.

THE general principles involved in operations and results obtained at the Presbyterian, Memorial, and Roosevelt hospitals in New York City are discussed in this paper.

Discussing the use of radium in these cases the author says that during the last six or eight years such advances have been made in radiotherapy of this lesion that results are far in advance of anything which was hoped for ten years ago.

In the General Memorial Hospital during the last seven years there have

been 27 per cent of three year cures, 14 per cent of four year cures, and 11 per cent of five year cures among the 200 or more cases of cancer of the lip referred for palliation only; of the 61 cases of cancer of the cheek treated by radium in this hospital there is here reported 35 per cent of three year cures.

The author says: "From the statistics of this report which I believe to be accurate, it will be seen that the results of surgical treatment of the lip are far superior to those obtained by radium, and that we are not justified at the present time in advising radium treatment in early operable cases. On the other hand, in cancer of the cheek, the results by radium are so evidently in advance of those obtained by operation, that until it can be demonstrated by a series of well observed three or five year cases, that operation gives equally good results, all cancers arising in the mucous membrane of the cheek should be treated by radium."

Our Faults in Writing. California M. J. 21:33, January, 1923.

THIS is a series of quotations taken from the United States Naval Medical Bulletin and reporting an address given by Dr. George H. Simmons, editor of the Journal of the American Medical Association. Thirty years in medical journalism have qualified Dr. Simmons to speak with some knowledge of his subject.

The length of an article is a ..atter of relativity—"A paper of 500 words may be long; one of 5,000 words may be short."

Lack of a logical plan, verbosity, and discussion of non-essential details ruin many an article. As a remedy Dr. Simmons suggests the use of cross headings and numerous revisions of the text during every one of which it will be found possible to eliminate many words, phrases, sentences, and sometimes whole paragraphs.

Allbutt and Osler among medical writers, and Lafcadio Hearn among lay writers are mentioned as men who attained their perfection of charm by the most painstaking and patient revision of one copy after another. Even up to his death this was Osler's method. If the master writers found this necessary, Dr. Simmons asks, should lesser lights feel any humiliation in putting it into practice?

Diagnosis and Treatment of Carcinoma of the Cervix. Wm. Neill, Jr., M.D., W. Virginia M. J. 17:258, January, 1923.

THERAPEUTICALLY speaking, cases are classified thus: "Early operable cases where the disease is limited entirely to the cervix; second, borderline cases, those with vaginal wall involvement and thickening in the parametrium; third, local inoperable cases with huge cervical growths and fixation of the parametria on one or both sides; fourth, cases with general metastases."

The mortality rate and the proportion of cures resulting from surgery are directly proportional to the duration of the lesion and to the size of the area involved. Removal of a local cervical growth by cautery or curet makes conditions worse.

Radium gives no mortality in any group and gives a large number of permanent cures in borderline cases. In the third group the percentage of immediate relief is high and may persist for years but clinical cures are only of a few years duration. In the last group palliation is all that can be hoped for.

Pre-operative radium therapy is favorably regarded for early cases—the increased difficulties of operation resulting therefrom can be avoided by a change in surgical technique. Immediate postoperative radiation is dangerous, as sloughing or fistula may result from it. Radiation from the surface of the body is never used alone in cervical cases unless extensive metastases exist.

In concluding the author says that in early operable cases where the disease is limited entirely to the cervix either radium or surgery alone is justifiable. In late operable cases he advocates radium locally over the growth and externally over the pelvis. In advanced cases he would use radium alone, locally or by implantation of bare radium emanation points.

Statistics and Technique in the Treatment of Fibromyoma of the Uterus by Radiotherapy. James A. Corscaden, M.D., Am. J. Roentgenol. 9:812, December, 1922.

THE information upon which this paper is based is derived from 250 cases treated at the Presbyterian Hospital, New York City. Two hundred and three of these cases have been treated during the period which began in June, 1914.

The paper discusses technique from the general standpoint and the procedures used in the treatment of fibromyoma of the uterus and hemorrhages from other benign causes.

The manifestations of the normal and the artificial menopause, psychoneurosis in particular, are quite fully described.

The author's conclusions are that (1) Radiotherapy of a myomatous or grossly normal uterus will stop all bleeding not due to ulceration and will cause a myoma to shrink more or less rapidly, also it will stop dysmenorrhea. (2) Radiotherapy will give only partial results in the relief of pain not associated with menstruation and in urinary distress. (3) As a result of the artificial menopause from radiotherapy hot flashes are the rule and there is in some patients an increased nervous irritability. In the majority of patients, however, nervousness diminishes, probably as a result of improved general well being. On the other hand those patients who are suffering from nervous disorders may be made worse. He remarks further that sexual changes are negligible, and that normal pregnancy is possible after temporary menopause. Blood pressure studies he regards as unreliable. In 16 per cent of the cases treated there seems to be an elevation of blood pressure.

What Is the Best Method for the Treatment of Uterine Fibromyomata by Means of the Roentgen Rays? M. Beclere, M.D., Paris. Am. J. Roentgenol. 9:797, Dec. 1922.

THE French and German theories regarding the action of x-rays upon the uterine fibromyoma are here contrasted. The Germans regard this treatment as an appendage to ovarian sterilization while the French believe that it forms a separate chapter in roentgen therapy. The Germans take the ovaries as the target while the French ray the entire uterine tumor without especial attention to the ovaries.

The author believes that the rays act immediately and directly upon fibromyomata of the uterus and that the immediate reduction of the tumor's size is not, at first, due to any change in hormones. He upholds his view by citing the fact that growth, retarded or increased, may and does often take place after the norma menopause.

The German technique of the single castration dose is reviewed. The author does not favor the single dose at one sitting but uses smaller doses weekly and believes that this method offers "better assurance of the progressive destruction of the neoplastic tissues" with total destruction of the ovarian follicles. Also these weekly sittings give better opportunity for observance of the patient's progress and he stresses the importance of watchful supervision and the proper appreciation of the physical aspect of the patient's condition. Often the proper word at a critical time will determine the course which the case will take. Irradiation malaise is likewise prevented by this method, and this should always be prevented if at all possible. The author does not regard it as a thing of trivial moment.

Each method, of course, has its advantages and its drawbacks, and each has its different requirements. "The judicious employment of a pliable method which can be adapted to the exigencies of each particular case is

always preferable to the blind acceptance of a uniform formula."

Pregnancy after either form of treatment the author believes cannot be hoped for, although one or two cases have been cited in the literature.

Radiotherapy of Uterine Bleeding. William H. Schmidt, M.D., Am. J. Electroth. & Radiol. 11:347, November, 1922.

AS A GUIDE to the selection of cases for radiotherapy the author gives the following: "(1) All tumors less than a four months pregnancy may properly be treated by radiotherapy. (2) All tumors not complicated with inflammatory condition of the adnexa may be treated with radiotherapy. (3) All tumors producing pressure demanding prompt relief or associated with pregnancy are surgical, but if pressure symptoms are not urgent it is justifiable to use radiotherapy. (4) All tumors showing distinct malignant changes had better be treated by radiotherapy first and followed by surgery. (5) Any case refusing operation or in poor physical condition justifies the use of radium or x-ray, except when complicated with inflammation of the adnexa or pregnancy." Debatable cases are those with complications unrelated to the uterus or adnexa among which are mentioned gall-bladder infections, stones, appendicitis, pathological changes in the kidneys, gastrointestinal lesions, perineal lacerations, fistula, hemorrhoids. Debatable also are cases of suspected malignancy or those where malignant degeneration is feared.

The author draws the following conclusions: "There is only a limited class of fibroid which belongs distinctly to the surgeon while the usefulness of radiotherapy is being extended. Idiopathic metrorrhagia at any age is purely a case of radiotherapy. Radium or x-ray will produce its same good effects and each must be employed according to its indication in each individual case. The mortality of radiotherapy is practically nil, while its economic factor, safety, freedom from discomfort, and large percentage of good results are greatly in its favor. Success depends upon proper technique and judgment and the selection of the best agent—radium or x-ray—suited to each individual case."

The Preoperative, Routine, Roentgenographic Examination of the Chest in All Cases of Breast Conditions. J. W. Frank, M.D., Pennsylvania J. Roentgenol. 4:4, October, 1922.

MANY physicians and surgeons do not secure an x-ray plate of the chest before operation of the breast but this should always be done for it will often reveal an unsuspected metastatic growth and amputation can produce no good result if there is an infiltration into the mediastinum or the lung.

The lymphatic system of the breast as described by Ewing's *Neoplastic Diseases*, 2nd edition, is reviewed in considerable detail after which the "why" of different lines of metastases is discussed.

Treatment of Carcinoma of the Breast by Radiation. Z. A. Johnston, M.D., Pennsylvania J. Roentgenol. 4:1, October, 1922.

OPERATION should be done in every early operable case. Anteoperative radiation is advised for the reason that it will reduce the amount of malignant tissue to be removed at the time of operation and will lessen the danger of local implantation.

These cases should have one complete series of deep x-ray treatments, with cross-firing around the axilla, supra-clavicular region and mediastinum. Packs of radium are used over the growth and in the axilla if there is any suspicion of glandular enlargement. Three weeks from this time radium needles are imbedded in the growth and three or four weeks later the case is turned over to the surgeon. A month after the operation a second course of treatment is administered. "No set rule as to treatment can be followed. A general plan of treatment can be modified for each individual case."

Border-line cases the author says are the most abused. Only one out of five of those with axillary enlargement can hope for lasting cure but thorough competent radiation increases the percentage of cure.

Hydatid Cyst of the Lung. Gerado M. Balboni, M.D., Boston M. & S. J., 187:879, December 14, 1922.

THIS paper reports two cases in one of which x-ray treatment was tried. Symptoms of hydatid cyst vary and they may simulate any pulmonary infection. The patient will not be conscious of any trouble until the cyst ruptures or the lung becomes inflamed or congested. "When rupture occurs into the lung structure the appearance closely resembles that of a lung abscess. The borders of the lesion are no longer sharply defined and the pleura may be involved, producing a marked limitation of the respiratory excursion of the diaphragm on the affected side."

The x-ray is the chief aid in diagnosis. Whenever possible surgery is the treatment, there is no medical treatment. X-ray was tried in one case but no improvement in symptoms or change in x-ray findings occurred.

Observations on Lung Suppuration and Its Treatment. W. Meyer, M.D., Arch. Surg. 6:361, January, 1923.

THIS paper deals principally with the nomenclature of lung suppuration, the results obtained with the help of the bronchoscope, and the establishment of a lung lip fistula in certain cases of bronchiectatic lung abscess.

Included in his discussion of diagnosis the writer has the following to say of the roentgen ray diagnosis of this lesion: "Stereoscopic roentgenograms present a beautiful plastic picture of diffuse density, but often fail to assist the surgeon in making the diagnosis of typical bronchiectasis. They are, however, of much value in cases of the typical lung abscess, as well as of the bronchiectatic lung abscess. Here they often demonstrate clearly the presence of one or more larger or smaller cavities, with a distinct fluid level.

"Much remains to be done, it seems to me, by roentgenologists in this type of disease. They must learn not only to determine the presence of an abscess, but also to localize more accurately the focus, and, if possible, the exact location of adhesions betwen the pulmonal and costal pleura. True, now and then they succeed in localizing correctly the seat of the trouble, telling us how many inches we have to measure from the spinous process of the seventh neck vertebra down, and how many from there to the right or left side, in order to find the spot where the aspirating needle should enter and strike the abscess. But these cases, up to date, are exceptions; and we are not advised so far at what depth we are likely to enter the cavity, how many inches below the surface of the thorax we may expect to find it.

"It is to be hoped and greatly to be desired that roentgenologists will devote further thought and investigation to this subject, in order to give the surgeon the real assistance which he needs when proceeding with his operative work on conservative lines."

Radium in the Treatment of New Growths of the Male Bladder. William Neill, Jr., M.D., J. A. M. A. 79:2061, December 16, 1922.

THE technique of this treatment is described. Treatment of tumors through the cytoscope must be limited to cases in which all parts of the growth can be clearly seen and outlined, otherwise suprapubic exposure should be employed.

The author reports perfect healing without complications.

Value of Gas Inflation in X-ray Diagnosis. F. Hernaman-Johnson, M.D., Brit. M. J. 2:511, September, 1922.

THE uses and risks of peritoneal inflation, the importance of careful

technique and the method of perirenal inflation introduced by Carelli of Buenos Aires, are the topics treated of in this paper.

Of this last procedure the author says that it is most difficult. He gives detailed directions for its use and illustrates the points of his description by an anatomical drawing and by a sketch of the apparatus in use.

The Choice of Pyelographic Mediums. Roger C. Graves, M.D., *and* Leo M. Davidoff, M.D., J. A. M. A. 80:168, January 20, 1923.

THESE authors believe that the use of 25 per cent sodium bromide is as unwise as it is potentially harmful. Its hypertonicity "in the presence of increased pressure may cause sufficient edema of the renal pelvis to occlude its outlet and so produce the picture of colic chills and fever, which too often follows pyelography." A 12 per cent sodium iodid isotonic with 8.2 per cent sodium bromid is the solution which they themselves use.

Cases for pyelography should be carefully selected. The patient who has extensive infection and depressed renal efficiency should be examined with great caution. A pyelographv in an ambulatory case is not advised.

The catheter should be advanced to the upper ureter or pelvis but not far enough to cause bleeding or pain. Drainage of the pelvic contents should be made and the medium then slowly injected, else pain will result. "The danger of high pressure within the bladder or renal pelvis cannot be overemphasized." The practice of waiting for pain to manifest itself before suspending injection is condemned. It is better to inject 7 to 10 cc. and then take a plate to determine the amount of further filling necessary. After examination the fluid should be withdrawn, and forced fluids, rest, and urinary antiseptics prescribed for the patient's comfort.

Important Points in the Technique of Roentgenological Examinations of the Urinary Tract. Bernard H. Nichols, M.D., Am. J. Roentgenol. 10:19, January, 1923.

DURING the last twenty years there has been an increasing accuracy in the diagnosis of diseases of the genito-urinary tract and this is largely due to the introduction of the cytoscope and the procedure of peritoneum.

The author insists always upon complete examination of the entire urinary tract, and he says that catheterization of the ureters with an opaque catheter will not suffice in examinations but ureterograms should be taken. Examination must be made in the horizontal position as well as standing, as in the latter position there is always danger of the liquid passing too rapidly into the bladder. Also he considers a convenient and practical table with a Potter-Bucky diaphragm absolutely essential for this work.

Experimental Cancer. Brit. M. J. 2: 1101, December 9, 1922.

A SERIES of papers upon different phases of the above subject are published in the journal cited above.

The first article is a short resume by J. A. Murray, M.D., of the literature upon "The Production of Cancer by Specific Forms of Irritation."

The title of the second paper is "Paraffin Cancer and Its Experimental Production," and its author is Archibald Leitch, M.D. Cutaneous cancer is here reported as occurring in paraffin workers in the oil-bearing shales of the West Lothian district of Scotland. Also this paper reports tumors produced in mice by repeated applications of crude shale oils. The article is bountifully illustrated with clinical photographs of workers as well as with illustrations of the experimental work recounted here.

Alexander Scott, M.D., presents a paper "On the Occupation of the Paraffin and Oil Workers of the Scottish Shale Oil Industry." He reports that epitheliomas occur among workers past middle life who have spent twenty years in this industry, but that long service in the industry stamps every patient.

These epitheliomas first appear as warts of benign nature. "The usual appearance is that of a gradually growing epithelioma in the midst of a chronic indurated dermatitis with numerous simple warts or indurated warty papules, only one of which has become malignant."

T. M. Legge, M.D., discusses the prevalency of "patch warts" among patent fuel workers. His article is entitled, "Epitheliomatous Ulceration in Industry" and is greatly condensed into tabular form. He reports that the percentage of warts which require treatment is comparatively small.

"The Experimental Production of Cancer by Arsenic" is the subject of a paper written jointly by Archibald Leitch and E. L. Kennaway, M.D. Rats and mice were used in these experiments which resulted in the production of cancer upon the exact spot where arsenic had been directly applied to the skin.

Further experimentation is contemplated by the authors, who, however, regard the evidence of cancer being produced in man by long continued labor in arsenical works as insufficient to merit serious consideration.

X-ray Cancer. Cecil Rowntree, F.R.C.S., Brit. M. J. 2:1111, December 9, 1922.

IN 1909 this author's records showed eleven English and nine American cases of x-ray cancer. Four English cases and one American case had terminated fatally previously to 1909. The author now reports three further deaths in England since 1909 (no record of American or other cases than English since 1909). Two new cases have developed in England since that time. This small number the author interprets to mean that preventive means have been successfully employed by workers of later years.

The clinical history of x-ray cancer is usually that of a severe burn followed by the appearance of warts, one of which develops into an ulcer and later on becomes carcinomatous. Often these warts are most innocent in appearance until microscopic examination is made when they are found to be malignant. The most extreme case of metastasis among these recorded cases is one where the growth extended up the arm until finally it reached the chin and lower lip. Four cases had involved the axillary glands, nine others had not done so at that time and seven of these still have not done so after a period of fourteen years since the first growth was removed.

X-ray cancer, the author believes, is of low malignancy and seldom recurs after excision of the first growth. A combination of burn plus a long succession of quite small exposures is necessary to produce this form of cancer. No case of x-ray dermatitis can be considered safe, however, until many years after the last exposure.

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A New Technique for the Positive Identification of the Sphenoid Sinus and the Ethmoid Cells*

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I REGRET that time will not permit me to review the excellent work done by others in this important field, but constrains me to limit my remarks to a brief description of the experiments which I have made on dried skulls and in one instance on the head of a living subject, and to show you the results obtained on these and on patients suffering with diseases of the accessory sinuses.

I was induced to make these experiments because of not being satisfied with the results obtained with the various techniques recommended. I had found that the diagnosis of disease of the sphenoid sinus could not be made with any degree of certainty, and in fact I could not be certain always of the positive identification of this sinus and of the ethmoid cells by known methods. Added to these difficulties were the ones of not being able always to show the same landmarks on skiagraphs of different heads and indeed not always on the same head when made at different times.

These last difficulties were unquestionably the result of some change, no matter how slight, in the position of the head and of the tube when the several exposures were being made. Conversations and correspondence with confreres brought out the fact that they were experiencing the same difficulties.

I was very fortunate while carrying out these experiments, in obtaining the cooperation of Dr. L. S. Gaudet, Lecturer on the Anatomy of the Ear, Nose and Throat in the Post-Graduate School of Medicine of Tulane University, who prepared the dried skulls, and filled the sphenoid sinus and the ethmoid cells with the opaque substances; and of Dr. G. J. Taquino, Assistant Professor of the Ear, Nose, and Throat in the same school, who furnished most of the clinical material for this study and who filled the sphenoid sinus of the living subjects with opaque material.

Too many thanks cannot be rendered to both these gentlemen for their unfailing interest and their invaluable assistance, without which this accurate and exhaustive study of the sphenoid sinus and the ethmoid cells could not have been made.

I wish also to render thanks to my technician, Mr. Guy R. Buisson, who developed the films and made the reductions and lantern slides, for his painstaking and efficient assistance.

First Experiment

A dried skull was sawed through the sagittal plane, just to one side of the nasal septum thus exposing to full view the sphenoid sinus and the ethmoid cells. On the right side, the sphenoid sinus was filled with plaster of Paris and the posterior ethmoid cells were filled with Mellotte's metal, and on the left side, the anterior ethmoid cells were filled with amalgam, after which the two halves of the skull were glued together.

Numerous skiagraphs of the skull were made in the postanterior position beginning first with the accepted 25°

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 8, 1922.

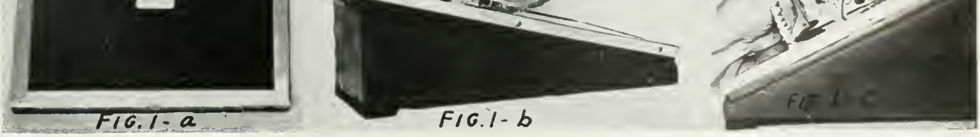

Fig. 1—(A) Author's head rest. (B) Sectional view of skull D resting on angle block in the position for making 107 degree angle skiograph. (C) Sectional view of the same skull resting on angle block in the position for making the 23 degree angle skiograph. The filled sphenoid sinus and the posterior and anterior ethmoid cells can be plainly made out. The path of the central rays, indicated by the vertical black line, is through the anterior ethmoid cells in C and through the upper portion of the sphenoid sinus in B, and the difference in the relative positions of the sphenoid sinus and the posterior and anterior ethmoid cells is seen in the 23 degree and 107 degree angle views is explained at once.

and 13° angles and then varying the position of the head and tube until the desired results were obtained.

To facilitate our work we had made out of wood and beaver board two light weight angle blocks of 25° and 13° respectively.

But our success was due mainly to the use during these experiments of a head rest which I had previously designed and which had proved of inestimable value when making postanterior views for the examination of the accessory sinuses.

This head rest (Fig. 1A) consists of a sheet of bakelite, with a triangular hole cut for the nose, attached to a wooden frame ½ inch high and about ¾ inch wide, the whole surrounded by a strip of wood ¼ inch thick and ¼ inch deep. By these means the bakelite sheet upon which the head will rest can be securely held over a film holder or cassette and at the same time kept a distance of ½ inch away. When the nose is placed in the hole cut out in the bakelite sheet—the size and position of this hole having been carefully determined—the head is automatically centered on the same part of the film, the soft tissues of the nose can be compressed without pain or discomfort and what is much more important, the head now rests *on the superior maxilla and the glabella.* Two constant fixed points, varying little in heads of different sizes and shapes, now afford good firm support to the head, doing away entirely with the tendency to pivot either in the direction of its longitudinal or transverse diameter, a tendency always present when the nose is one of the two points on which the head rests.

This was definitely and abundantly proved during our experiments with the dried skulls. By making use of the head rest described above, we were able to reproduce skiagraphs identical in every particular as often as desired.

Landmarks

As a result of these experiments, I present for your consideration Figure 2A, a postanterior view of a skull resting on a 23° angle block. The shadows cast by the filled sphenoid sinus and by the ethmoid cells are clearly brought out and can be readily seen. You will observe (1) that the sphenoid shadow is bounded above by the line X. This line X is formed by the anterior border of the optic groove, and the upper roots of the lesser wings of sphenoid. The shadows produced by the lesser wings of the sphenoid can be seen continuing outwards through the orbits; (2) that as is nearly always the case one sphenoid, the right one in this skull, is larger than the other; (3) the anterior ethmoid cells are situated just below the frontal sinuses.

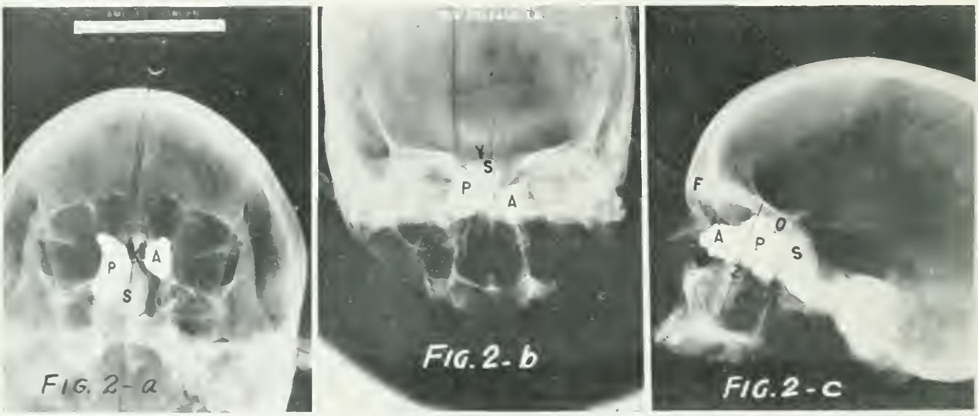

Fig. 2—Skull A, with the sphenoid sinus and the posterior ethmoid cells on the right side and the anterior ethmoid cells on the left side filled with opaque materials. (A) Posterior anterior view 23 degree angle: X. upper boundary of the sphenoid sinus. (B) Posterior anterior view 107 degree angle: Y, upper boundary of sphenoid sinus. (C) Lateral view: O, anterior boundary of sphenoid sinus. Z, boundary line between the anterior and the posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

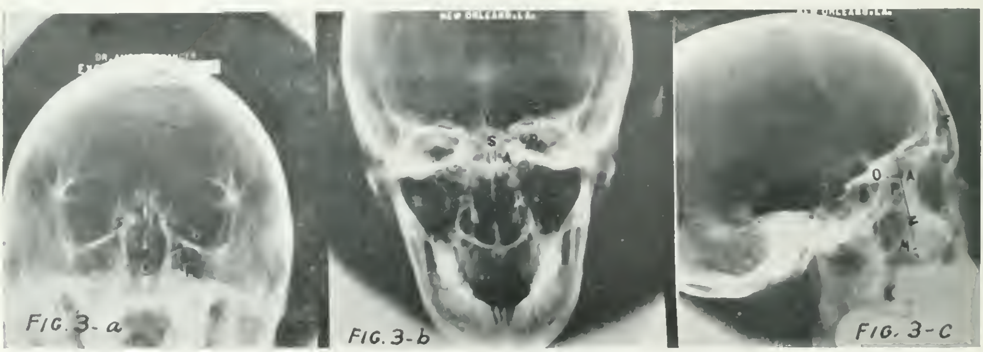

Fig. 3—Skull B: (A) Posterior anterior view 23 degree angle: X upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle; Y, upper boundary of sphenoid sinus. (C) Lateral view; O, anterior boundary of sphenoid sinus; Z, boundary line between the anterior and the posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

Figure 2B is a postanterior view of a skull resting on a 107° angle block. It shows the sphenoid sinus and the groups of ethmoid cells appropriately marked, clearly defined, and limited by the different densities of the opaque substances with which they are filled. You will observe that the sphenoid shadow is bounded above by the curved line Y. *This line which I consider the most valuable landmark is formed by that portion of the bony wall of the sphenoid called the optical groove.* It curves downward on each side towards the optical foramen and the anterior clinoid processes.

Making use of my head rest, in order to have the head rest firmly on the superior maxilla and the glabella, and with the 17° angle block placed so as to give the head an inclination of 107° no difficulty whatever was experienced in making post-anterior skiagraphs showing the very important landmark described above.

You will observe further that the shadow of the filled ethmoid cells is bounded above by a line formed by the lesser wing of the sphenoid and which extends outwards and usually upwards; and its inner boundary is indicated by the vertical line formed by the superior turbinate bones. The posterior cells lie above and the anterior cells below the shadow of the middle turbinate bones.

Figure 2C, the lateral view of the same skull, shows the shadow of the filled sphenoid bounded anteriorly by the curved line formed by the shadow of the greater wing of the sphenoid. This line which serves as the anterior boundary of the middle cerebral fossa also serves as a fairly constant and accurate boundary line between the sphenoid shadow and that of the posterior ethmoid cells. A line Z arbitrarily drawn along the posterior border of the orbital process of the malar serves as a fairly accurate boundary between the posterior and the anterior groups of ethmoid cells. I doubt whether a more practical boundary line can be found because although the shadow produced by the anterior ethmoid cells is usually larger than that produced by the posterior cells on account of the larger number of the former, it happens not infrequently that the posterior cells are of such large size that they produce a shadow as large and even at times, larger than that produced by the anterior cells (Fig. 2).

Three other skulls were obtained—Skulls B, C, D—and it can be seen from their photograph (Fig. 9) that

Fig. 4—Skull B, with the sphenoid sinus and the ethmoid cells filled with opaque materials on the left side. (A) Postanterior view of 23 degree angle; X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle; Y, upper boundary of sphenoid sinus. (C) Lateral view; O, anterior boundary of sphenoid sinus; Z, boundary line between the anterior and the posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

Fig. 5—Skull C: (A) Posterior anterior view 23 degree angle; X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle; Y, upper boundary of sphenoid sinus. (C) Lateral view; O, anterior boundary of sphenid sinus; Z, boundary line between the anterior and posterior ethmoid cells. S sphenoid cells. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

they varied greatly in size and shape. They were each sawed in the sagittal plane the same as Skull A, but this time it was decided to fill the sphenoid sinus and the two groups of ethmoid cells on the same side provided that three substances opaque to the x-rays could be obtained which would produce shadows of different densities so that these could be differentiated on the skiagraphs.

After considerable experimentation, it was found that this could be done by filling the sphenoid sinus with plaster of Paris, the posterior ethmoid cells with a thick paste of sapolin and the anterior ethmoid cells with zinc oxide powder worked into a paste with oil of cloves. A study of Figures 3 and 4, 5 and 6, 7 and 8, sets of skiagraphs made of skulls B, C, and D, respectively, before and after the sphenoid sinus and the ethmoid cells were filled with the substances mentioned above, demonstrates conclusively: (1) that by employing the technique recommended, it was possible to duplicate the skiagraphs with great precision; (2) that the skiagraphs of these three skulls do not show as great differences in their appearance as their photographs do (Fig. 9); and (3) that the important landmarks previously described can be readily and positively identified.

A careful study of Figure 11, a set of skiagraphs of the head of a normal individual made by employing this technique and showing clearly all the landmarks described, should prove highly instructive.

Figure 10, a set of skiagraphs of the head of a patient on whom a radical operation for frontal, ethmoid and sphenoid sinusitis was performed several months ago, and in whose sphenoid sinus a thick paste of bismuth was packed through an unusually large opening resulting from the radical operation, is most interesting because it proves in the living head the accuracy of the landmarks obtainable with the method of examination recommended.

It will be observed that the shadow produced by the bismuth paste (Fig. 10) lies below line X (the upper boundary of the sphenoid sinus in position A); below the curved line Y

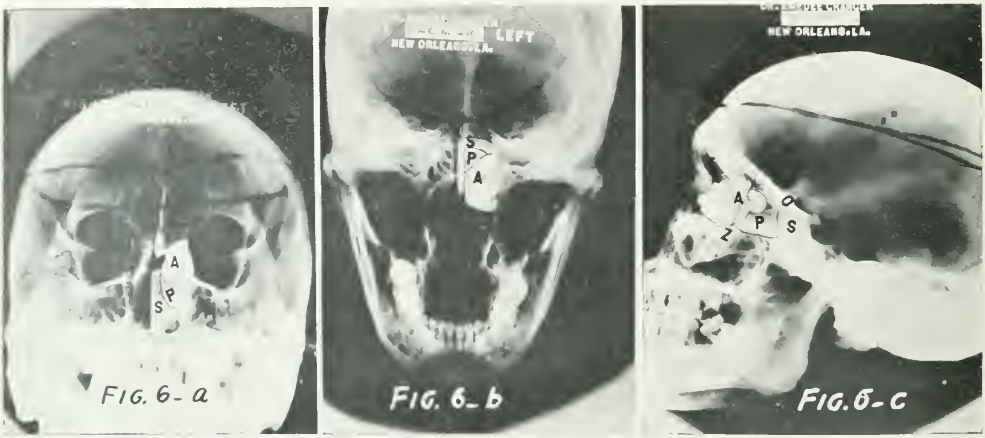

Fig. 6—Skull C, with the sphenoid sinus and the ethmoid cells filled with opaque materials on the left side. (A) Anterior view 23 degree angle; X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle; Y, upper boundary of sphenoid sinus. (C) Lateral view; O, anterior boundary of sphenoid sinus; Z, boundary line between the anterior and the posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

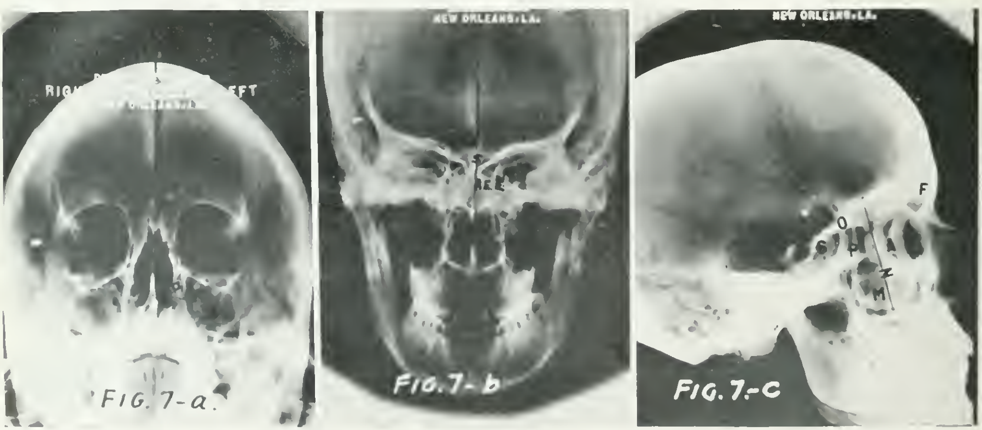

Fig. 7—Skull D: (A) Posterior anterior view 23 degree angle: X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle: Y, upper boundary of sphenoid sinus. (C) Lateral view: O, anterior boundary of sphenoid sinus; Z, boundary line between the anterior and the posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

(the upper boundary of the sphenoid sinus in position B); and behind the curved line O (the anterior boundary of the sphenoid sinus in position C).

It will be observed further that the opaque shadow does not reach the lines X and Y because the hyperplastic changes in the mucous membrane lining the sphenoid sinus prevented the bismuth paste from getting closer to its bony wall. These hyperplastic changes are clearly shown in the very marked increased density to be seen below the sphenoid curve Y.

Interpretation and Diagnosis

When studying Figures 4, 6, 8, of the filled skulls, it must be noted that the shadows of the filled sinuses occupy the following order from above downwards, viz: Anterior Ethmoid, Posterior Ethmoid, Sphenoid in Position A (23° angle) and Sphenoid, Posterior Ethmoid, Anterior Ethmoid in Position B (107° angle) because this has an important bearing on the interpretation of these skiagraphs.

A glance at B and C of Figure 1, a cross section view of a filled skull in proper position on the head rest, and on the 107° angle and the 23° angle blocks respectively, with the path of the central ray indicated by a vertical black line when the skiagraphs in position II and I respectively were made, will give the explanation of the observation noted above.

It was noted further that whereas the curved line Y is plainly seen in its entirety in the skiagraphs of the unfilled skulls, it was seen faintly or not at all in the skiagraphs of the filled skulls on the side which is filled, where its shadow blends with that of the opaque material filling the sinus, but remains distinctly visible on the unfilled side. This observation is of the greatest diagnostic value as will be shown later. (See Figs. 7B and 8B.)

Although convinced that position B gives the most important information concerning all the sinuses except the frontals, I do not consider that a thorough examination of the accessory sinuses has been made unless the head has been skiagraphed in positions A and C also. Position A besides furnishing very valuable data with regard to the frontals and the maxillary becomes a valuable check on the findings obtained from position B. While position C checks up and confirms the findings in the other two positions of the head and in cases where the disease of the sphenoid is looked for gives additional and valuable information regarding the size and density of that sinus, and the size and condition of the sella and of the anterior clinoid processes.

For example, cloudiness or opacity immediately below the line Y with this line indistinct, absent, or thickened in position B; below line X and extending to or beyond the median line in position A; and behind curved line O in position C, with or without alterations of the sella and the anterior clinoid processes, means pathology or abnormality of the sphenoid sinus.

Cloudiness or opacity of the lower portion of the ethmoid region in position B, in the upper portion of the same region in position A, and in front of line Z in position C means pathology

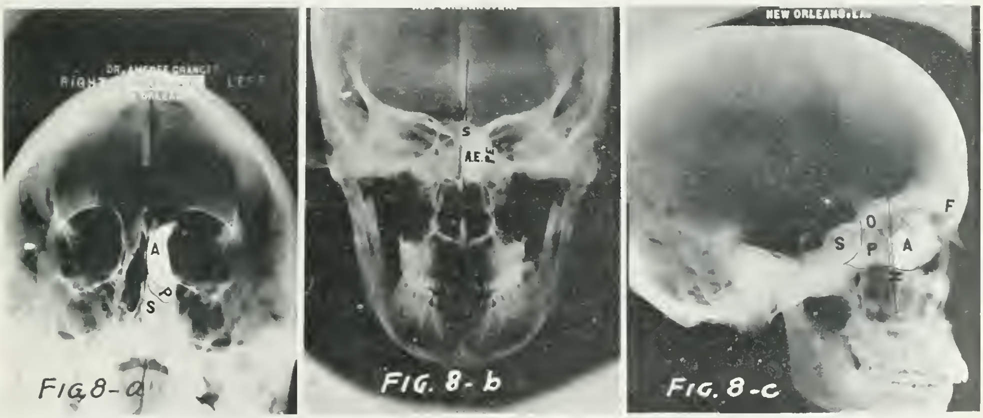

Fig. 8—Skull D, with the sphenoid sinus and the ethmoid cells filled with opaque material on the left side. (A) Posterior anterior view 23 degree angle: X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle: Y, upper boundary of sphenoid sinus. (C) Lateral view: O, anterior boundary of sphenoid sinus; Z, boundary line between the anterior and the posterior ethmoid cells. S sphenoid sinus; P, posterior ethmoid cells. A anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

Fig. 9—Skulls B, C, D.

or abnormality of the anterior ethmoid cells.

Although the time is too short and the clinical cases proved by operation too few to enable me at this writing to lay down any hard and fast rules of interpretation, nevertheless the following important observations have been recorded and have proved of inestimable value since with their knowledge I have been able to diagnose unilateral sphenoid disease and in several instances, when disease of the sphenoid was suspected, to state correctly that such was not the case.

Indistinctness or absence of the curved line Y (position B) either on one side or in its entire length, with increased density or opacity of the sphenoid region was noted when one or both sinuses were filled with polypoid tissue (Fig. 12).

Increased thickness or density of the curved sphenoid line on one side or throughout its entire length, produced unquestionably by osteoplastic changes in the sub-periosteal bone of the sphenoid, associated with cloudy or opaque sphenoid sinus and ethmoid cells, and with similar hyperplastic changes in the ethmoids seen in the increased visibility of the walls of the ethmoid and their cell divisions, was observed in several cases of chronic suppuration of the sphenoid and post-ethmoids (Fig. 13).

In a patient suffering with optic neuritis on the right side, the right half of the curved sphenoid line was found to be thickened (Fig. 14).

I have become convinced that it is possible by a careful study of a set of skiagraphs made in the three positions recommended, noting particularly changes in the curved sphenoid line Y, in the density of the shadow of the sphenoid sinus and the ethmoid cells, changes in their walls and in the case of the ethmoid cells of the cell divisions, to make earlier and more positive diagnoses of diseases of the sphenoids and the ethmoids than was possible heretofore.

Furthermore, I believe that the results already obtained from our experiments and observations justify us in making the following statements which we hope to see corroborated at an early date. In cases of acute sphenoid sinusitis, when the sinus is filled with pus, but when no hyperplastic changes have taken place, the sphenoid region should be denser and the curved sphenoid line indistinct or absent on the affected side, if only one sinus is diseased, and throughout its whole length if both sinuses are diseased.

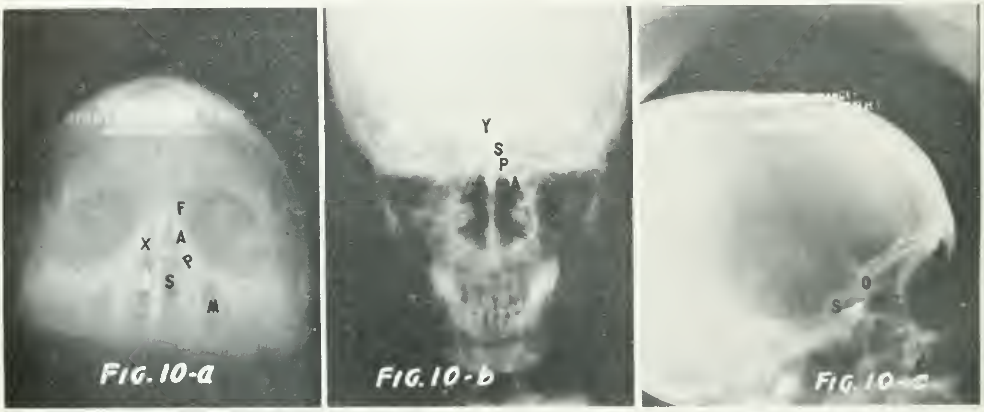

Fig. 10—Right sphenoid sinus of a living subject filled with bismuth paste. (A) Posterior anterior view 23 degree angle: X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle: Y, upper boundary of sphenoid sinus. (C) Lateral view: O anterior boundary of sphenoid sinus; Z, boundary line between anterior ethmoid cells and posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

Fig. 11—Normal sinuses in a living subject. (A) Posterior anterior view 23 degree angle: X, upper boundary of sphenoid sinus. (B) Posterior anterior view 107 degree angle: Y, upper boundary of sphenoid sinus. (C) Lateral view: O, anterior boundary of sphenoid sinus; Z, boundary line between the anterior and posterior ethmoid cells. S, sphenoid sinus. P, posterior ethmoid cells. A, anterior ethmoid cells. M, maxillary sinus. F, frontal sinus.

In cases of glioma or other tumor of the base of the brain in the region of the optic groove, besides the changes usually seen in the anterior clinoid process in the lateral view, the 107 angle view should show definite alterations of the curved sphenoid line.

In cases of neoplasm of the sphenoid sinus, besides the changes usually seen in the region of the sella turcica in the lateral view, the 107 angle view should show definite alterations of the curved sphenoid line with changes in the sphenoid region.

The importance of this work can well be attested by the workers in radiology who have been groping their way in the past, by the otolaryngologists who have been disappointed by inadequate and very often inaccurate information furnished them by the roentgenologist,

Fig. 12—Left sided chronic sphenoid and ethmoid sinusitis with polypoids. Increased density of the left sphenoid, ethmoid and maxillary sinus regions. curved sphenoid line (Y) not visible on left side.

Fig. 13—Chronic pan-sinusitis on the right side. The right side of the line Y is very much thickened, and the sphenoid sinus, the ethmoid cells and the maxillary sinus are all very opaque on the right side.

Fig. 14—Neuritis of the right optic nerve. The right half of the curved sphenoid line (Y) is very much thickened, and the sphenoid and ethmoid regions are slightly denser on the right side, suggesting hyperplastic changes.

and more especially by recent statements of such eminent authorities as the late Dr. James Gerritt Van Zwaluwenburg, who said in a paper read before the American Roentgen Ray Society in Washington, "Unilateral sphenoiditis presumably does occur but has not been recognized in this laboratory." And Dr. Greenfield Sluder who in his excellent work, *Concerning Some Headaches and Eye Disorders of Nasal Origin*, says in the chapter on hyperplastic sphenoiditis, "The hyperplastic disease involves not only the bones, but the soft parts covering it, and the hyperplastic bone process with or without periostitis causes thickening of the bone which in turn narrows one or more of the canals through which the cranial nerves pass. When this hyperplastic process involves the outer upper and anterior portion of the sphenoid, it may become localized about the optic canal, often producing impaired vision by pressure from bone extension or by irritation from the proximity of the inflammatory process. Even after removal of the anterior wall of the sphenoid and the introduction of a Holmes pharyngoscope into the sphenoid sinus the forward and backward vision is very limited." In just this class of cases a study of the curved sphenoid line Y would prove of immense service by furnishing very reliable information regarding the condition of the outer-upper-anterior wall of the sphenoid.

1212 Maison Blance Bldg.

X-Rays and X-Ray Apparatus; An Elementary Course*

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II.
The Interrupterless Transformer
(Continued)

15. In Section 10[1] it was stated that the strength of the current flowing through the primary of the transformer might be altered by changing the amount of resistance in the circuit, that is, by moving the rheostat control. By this means the magnitude of the high voltage driving the current through the secondary (the tube) circuit may be altered. This raises certain questions. In any given outfit, what is the value of the high tension voltage? What is the range of voltages which may be obtained? What is the difference between different machines in this respect? Is the rheostat the only means of regulating the actual voltage across the tube? The answer to these and to other questions of the same nature will be given in the paragraphs which follow.

*—Received for publication Jan. 5, 1923.

Measurement of High Voltage

16. First of all, then, how is high voltage measured? This may be done in at least four different ways; by means of (1) the spark gap, (2) a voltmeter across the primary terminals of the transformer, (3) the electrostatic voltmeter, (4) the so-called crest meter. Before looking briefly at each method it is well to note that in x-ray work what is invariably wanted is the effective high voltage across the terminals of the tube when it is being used. This is not the same as the maximum voltage (E.M.F.) got up by the transformer.

To utilize the first method, a spark gap consisting of two insulated conductors A and B (Fig. 23) whose distance apart may be varied, is placed in parallel with the tube. With the tube running, the distance between the gap terminals is gradually shortened until a spark takes place. *The length of this spark is a measure of the voltage across the tube or of what is technically called the "back-up" of the tube.* If the length of the gap is initially too great and it is slowly shortened, it should be evident that the "back-up" is a measure of the crest or peak voltage across the tube. (If readings are taken of spark length when tube is not in the circuit, a value of the maximum voltage got up by the transformer is obtained).

It is highly important to note that the sparking distance will depend on the nature of the terminals used. In practice, gaps between points, and gaps between spheres are utilized. Not only are voltage values for equal distances very different in the two cases, but even for sphere gaps, the values vary with the size of the spheres. A glance at Table I (taken from Kaye and Laby's Physical Constants, Edition IV) will show the way in which the spark length

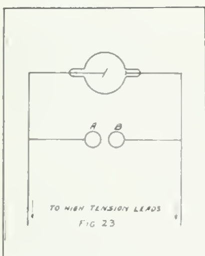

FIG 23

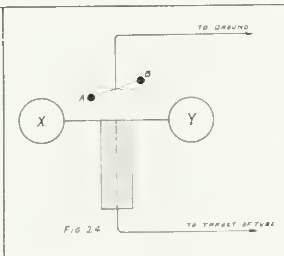

FIG 24

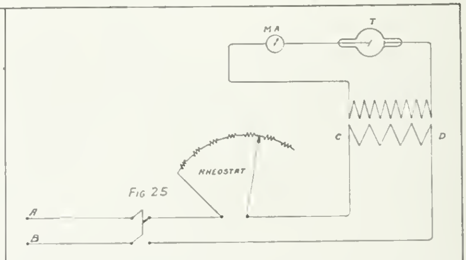

FIG 25

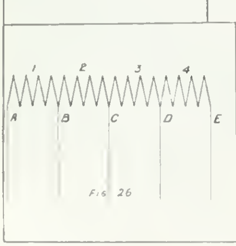

FIG 26

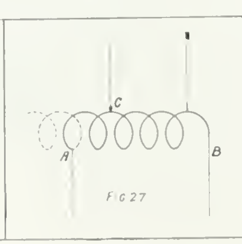

FIG 27

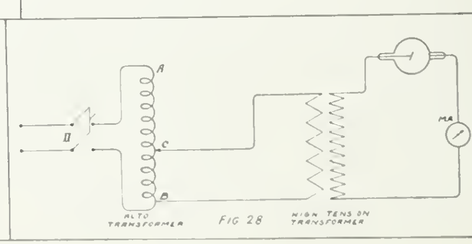

FIG 28

TABLE I.

(Sparking voltages at 25 C and 760 mm. pressure)

Kilo Volts (Peak)	— Needle Points — No. 00 New Sewing Needles cms. gap.	inches gap.	Spheres Diameter 5 cms. cms. gap.	Diameter 10 cms. cms. gap.	Diameter 25 cms. cms. gap.
10	....	....	0.29	0.30	0.32
15	1.30	0.51	0.44	0.46	0.48
20	1.75	0.69	0.60	0.62	0.64
25	2.20	0.87	0.77	0.78	0.81
30	2.69	1.06	0.94	0.95	0.98
35	3.20	1.26	1.12	1.12	1.15
40	3.81	1.50	1.30	1.29	1.32
45	4.49	1.77	1.50	1.47	1.49
50	5.20	2.05	1.71	1.65	1.66
60	6.81	2.68	2.17	2.02	2.01
70	8.81	3.47	2.68	2.42	2.37
80	....	....	3.26	2.84	2.74
90	....	....	3.94	3.28	3.11
100	....	....	4.77	3.75	3.49
110	....	....	5.79	4.25	3.88
120	....	....	....	4.78	4.28
130	....	....	....	5.35	4.69
140	....	....	....	5.97	5.10
150	....	....	....	6.64	5.52
160	....	....	....	7.37	5.95
170	....	....	....	8.16	6.39
180	....	....	....	9.03	6.84
190	....	....	....	10.0	7.30
200	....	....	....	11.1	7.76
210	....	....	....	....	8.24
220	....	....	....	....	8.73
230	....	....	....	....	9.24
240	....	....	....	....	9.76
250	....	....	....	....	10.3

varies for different gaps. It will be noted, too, that for smaller voltages, the change in the distance, for a given change in voltage, is greater in the case of needle points, and for that reason, this kind of gap has an advantage for lower voltages. Its use is not to be recommended, however, because the sparking voltage, for a given distance, varies with variable conditions, such as humidity, sharpness of points, etc. With the very high voltages used in deep therapy, a needle gap is useless. In this case the sphere gap as standardized by the American Institute of Electrical engineers should be used[2]. Provided spheres are used whose diameters exceed that of the spark length, no such inconsistencies exist.

One or two further points, however, should be noted. The voltage corresponding to a given distance varies, not only with the size of the spheres, but also with the atmospheric pressure and air temperature. Table II, for example, shows the correction which must be applied to the values given in Table I. To illustrate, with spheres of diameter 10 cm., at a pressure equal to 740 mm., and temperature equal to 20 C. the voltage corresponding to a distance of 2.02 cm. is not 60,000 but 60,000 times 0.99. Unlike the needle point, however, the sparking voltage for a given distance is independent of the humidity and the frequency (within the limits of values used in commercial A.C.) But because of changing spark length with size of spheres, temperature and pressure, it should be evident that the practice in x-ray work of expressing the voltage across the tube by a spark *length*, even when a standard sphere gap is used, should be discontinued. An accurate comparison of the work of one observer with another is possible only when voltages are expressed in kilovolts.

An objection to the use of a sphere gap must next be noted. With the gap set at a certain distance, a spark will jump whenever the potential difference between the spheres has the corresponding voltage value. This means that should this voltage be attained as a result of only a momentary surge in the circuit, sparking will still occur. Now, it will be seen when we come to the subject of dosage, that this may lead to very erroneous conclusions, for the sudden rise in voltage may last for such a small fraction of the whole half-cycle, that the effect of the x-rays due to it, is almost negligible. To overcome this difficulty, so-called crest meters (See Section 20) which do not respond to these short sudden rises are sometimes used. In spite of this objection, however, the use of a standard sphere gap has much to be said in its favour.

17. The question of sparking voltages has an important bearing on the use of a rectifier such as was described in Section 8[1]. It was there pointed out that the portion of the rectified half-wave utilized depended on the length of time the revolving metal pieces, 1, 2, 3 and 4 were in contact with the fixed brushes. It should now be evident that *contact will be made as soon as the voltage is high enough to cause a spark to jump across the gap between the brush and the rotating part.* Since in the type of rectifier described (and most others) the metal pieces have sharp corners, it follows that we are here concerned with sparking between points. This means that there is much uncertainty about the exact portion of the half wave which is utilized. Indeed there will be in general a variation with conditions, both electrical and atmospheric. Now, for ordinary radiographic purposes this may have no serious consequence; in deep therapy, however, as will be seen later, it is important to use always the same portion of the half-wave (and that the smallest possible). To meet this need, a so-called *constant rectifier* has been placed on the market. The principle utilized is exactly the same as that already described, but brushes in the form of spheres, and thick revolving parts with smooth curved surfaces, are used so that sparking occurs essentially between spheres. By this means all the uncertainties of sparking between points are eliminated. A description of such a rectifier will be found in a pamphlet, *A Precision X-Ray Apparatus*, by Montford Morrison, of the Acme X-Ray Company, Chicago.

18. A second means of measuring the "back-up" of a tube is found in the use of an ordinary A.C. voltmeter across the primary terminals of the high tension transformer. As the primary voltage changes, so, too, will the high tension voltage. Accordingly, for any given machine, the ordinary voltmeter may be calibrated once for all, and an exact relation obtained between its

TABLE II.

Temp.	Press. 720 mm.	Press. 740 mm.	Press. 760 mm.	Press. 780 mm.
0° C.	1.04	1.06	1.09	1.12
10	1.00	1.02	1.05	1.08
20	0.96	0.99	1.02	1.04
30	0.93	0.96	0.98	1.01

2

readings and the high voltage across the tube. To do so, it is necessary to utilize a standard sphere gap and to take simultaneous readings of back up and of primary voltmeter. Unfortunately, to quote from a recent article[3] by Dr. W. D. Coolidge and W. K. Kearsley, "The primary voltage required to produce a given high tension voltage will depend on the milliamperage (that is, on the current through the tube). It is then necessary to calibrate against the sphere-gap for the exact milliamperage which is to be employed." Another objection to this method is found in the fact that a very slight change in the primary voltage may mean a considerable change in the high tension voltage, although by proper design of the transformer this may be minimized to some extent. In spite of these objections a primary voltmeter, accompanied by a calibration table for different milliamperages, should be useful.

ELECTROSTATIC VOLTMETER.

19. The fundamental principle involved in the use of electrostatic voltmeters may be described by giving the details of one used by Dr. William Duane of Harvard University. This instrument consists essentially of a fixed part, two large metal spheres X and Y (Fig. 24) mounted on a highly insulated support, and a movable part, consisting of two metal balls A and B suspended so as to be free to rotate about a vertical axis. In using the instrument one side of the tube is joined to earth (grounded) while the other side (the target) is joined to the insulated metal balls of the instrument. As the movable balls are joined to earth, there exists between the fixed and the movable parts of the voltmeter, the same potential difference as between the two sides of the tube. The part AB rotates an amount which depends on this difference of potential, hence the magnitude of the latter is obtained by reading the deflection. It is, of course, necessary to calibrate the instrument by comparison with a standard sphere gap, or by using known high voltages such as were available for Dr. Duane.

(In passing it may be noted that the Bauer qualimeter, an instrument used to measure the penetrating power of x-rays—to be discussed later—is essentially an electrostatic voltmeter).

THE CREST METER

20. To avoid the error in connection with the use of a standard sphere gap when momentary surges in the voltage occur, the use of the so-called *crest meter* has been recommended. In this instrument use is made of the means originally employed by Fortescue and Chubb[4] for calibrating fundamentally a sphere gap. An air condenser (See Section 33) is charged by the high voltage (to be measured) across the tube and the charge stored in the condenser is discharged through a galvanometer. Now, since for the same condenser, the current (when the condenser is rapidly charged and discharged) is proportional to the voltage to which it is charged, it follows that the deflection of the galvanometer is proportional to the voltage. Accordingly, with such an arrangement the scale on the galvanometer may be marked so as to read the number of kilovolts across the tube. It has the great advantage that at all times during the operation of the apparatus, the voltage across the tube is known. Further details in connection with such an instrument will be found in the article by Montford Morrison to which reference has already been made.

"CAPACITY" OF AN X-RAY OUTFIT.

21. It is important for the reader to realize that the transformer is a means of supplying electrical energy to the x-ray tube. Now the actual amount of electrical energy supplied any portion of an electric circuit depends on three quantities: (1) the voltage, (2) the current, (3) the time[5]. Since the time factor is so readily taken care of, usually we consider the energy supplied per second or what is known as *the power*, which obviously, then, depends on the voltage and the current. [Compare the power available from a water-fall which depends on (1) the head of water, (2) the quantity of water coming over the fall per second. One million gallons falling from a height of 50 feet represent the same power as half a million gallons from a height of 100 feet.] To be more definite, when a current of 1 ampere is flowing in a portion of a circuit under a potential difference of 1 volt, the power is 1 volt-ampere or 1 watt. (746 watts equal 1 horsepower.) If 50 amperes flow under a potential difference of 110 volts, the power is 50 × 110 or 5500 watts. An electric toaster consuming 550 watts when operated on 110 volts has a current of 5 amperes flowing through it. When, therefore, the voltage used to drive 10 milliamperes through an x-ray tube is 20,000 volts, the power supplied the tube is proportional to 10/1000 × 20,000 or 200 watts. The product does not give the exact value of the power in watts because although the current may be the correct average value, the voltage value in general is not the average, but probably the maximum (crest) value during a half cycle. Generally speaking, however, *we may compare the amounts of energy supplied a tube each second under different conditions by comparing the products of the effective crest voltage between its terminals times the current flowing through it.*

Now the so-called "capacity" of an outfit refers to the maximum energy

FIG 29

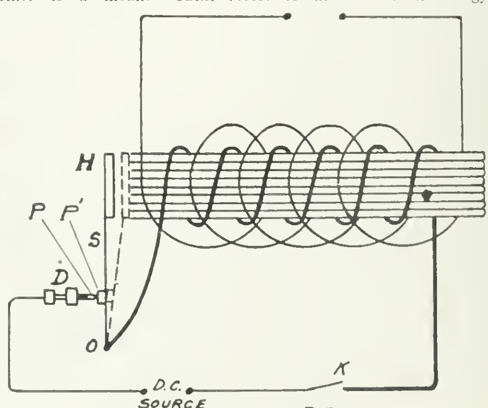

FIG. 30

per second it is capable of supplying an x-ray tube. (The word "capacity" is not a very happy one, as in electrical science capacity has a very definite and distinctly different meaning. See Section 33.) It is usually expressed by giving the value of the maximum current which can be supplied a tube, under a specified "back-up." For example, in advertising literature one finds statements such as the following: A certain unit is "capable of energizing the 30 ma. 5-inch Coolidge Tube;" the output of another is "rated at 250 ma. at a 6-inch back-up between points." Such statements do not mean that the transformer may not be able to maintain a much higher voltage across a tube than the one stated. For example, in connection with the second of these outfits, the catalogue states further that "the *maximum* spark gap between points is 12 inches." Should higher voltages (than those corresponding to a 6-inch gap) be utilized, a correspondingly smaller current would be supplied, because, once more, the energy supplied depends on both the current and the voltage, and in this case, cannot exceed an amount proportional to the product (250 ma. times voltage corresponding to a 6-inch gap between points). Occasionally one sees advertised a machine capable of giving, say, a 20-inch spark, with no mention of the current. It should be evident that such a statement does not give all the necessary information, unless, indeed, it is assumed that at such a voltage only very small milliamperages will be used.

22. The capacity of an x-ray unit is sometimes expressed in terms of the maximum power which may safely be supplied the primary of the high tension transformer. For example, a machine is sometimes advertised as having a capacity of 5 kw. (5 kilowatts = 5000 watts). This means that, if operated on 220 volts, primary currents as high as 5000/220 or over 22 amperes may be utilized[6]. Since there is very little loss of energy in a good transformer, a 5 kw. unit can deliver nearly that same amount on the high tension side. It does not give, however, any information regarding the value of the highest voltage which may be generated, since, as noted in section 7[1], this depends on the ratio of the number of turns of the secondary coil to that of the primary.

23. In passing we may note that, quite apart from the capacity of the high voltage generating outfit, an x-ray tube has a maximum capacity. The -inch Coolidge tube, for example, is capable of carrying continuously abou kilowatt. Later, in discussing the action of the gas and the Coolidge tubes, details in connection with this question will be considered, but it is well to note here that it is again simply a question of how much energy per second it is safe to supply the tube.

Control of Back-Up.

24. In Section 21 reference was made to a machine with a capacity of 250 ma. at 6-inch back-up, capable also of generating a maximum voltage corresponding to a 12-inch gap. With this machine, as with all others, there is evidently a range over which different voltages may be utilized. How, then, we next ask, is an operator able to alter the voltage available for the tube circuit? Three different means are utilized: (1) the rheostat, (2) primary convolutions, (3) the auto-transformer.

(1) *The Rheostat*—Reference has been made already to the use of the rheostat. One or two further points should be noted. Whenever a current has to flow against resistance, heat results (compare motion against friction) and there is a certain loss of power. Moreover, since voltage is necessary to cause the flow of a current against resistance, *there is always a drop in voltage along a line containing resistance.* The magnitude of this voltage drop depends both on the current and the resistance—the greater each of them, the greater the drop. It follows, therefore, that if, at the main leads A and B (Fig. 25), there is a supply of say 110 volts, the voltage across C and D, the terminals of the primary of the high tension transformer is less than 110 by an amount which depends on the resistance utilized in the rheostat and the current strength. In the case of the gas bulb, this has a decided advantage over the auto-transformer control (See "3" of this section). Suppose the resistance of a gas bulb T (Fig. 25) suddenly lowers. (For reasons to be given later this may happen). This means that the high secondary voltage at once causes a greater current in the tube circuit, and consequently automatically a greater current flows through the primary (to supply the necessary energy). Since, however, a rheostat is in the primary circuit, *this current increase means an increase in the voltage drop through the rheostat, and therefore the voltage applied to the primary of the transformer lowers.* As a result of this, the high tension voltage will lower also, hence the tube current will lower again. In this way a rheostat acts as a kind of safety valve preventing a sudden increase of current beyond the capacity of the outfit. This is not so in the case of the auto-transformer.

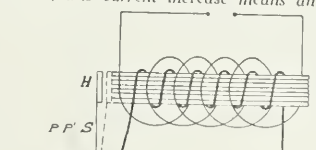

Fig. 31

(2) *Convolutions*—In some units the rheostat is supplemented by an additional control in the form of what are called convolutions. This simply means that the primary coil is wound in sections, so that different numbers of turns in the primary may be utilized. For example in Figure 26, it is evident that by using terminals A and C, sections 1 and 2 of the transformer would be utilized; by using A and D, sections 1, 2, and 3 would be utilized, and so on. By such means the ratio between the number of turns of the primary and that of the secondary may be altered by steps and in this way the maximum high tension voltage changed by corresponding amounts. In one catalogue, the writer has seen a machine advertised with convolutions so arranged that voltages of 25, 45, 65, 80 and 100 thousand may be obtained. By using a rheostat on the line in the usual way, a finer control of high tension voltages is possible and intermediate value may readily be obtained.

(3) *The Auto-Transformer*—This is practically a transformer with only the primary winding, or, one where the same coil serves both as primary and secondary. Suppose (Fig. 27) AB represents such a coil, with the usual iron core not shown. Then if 110 volts A. C. are applied to the coil across AB, between the end B and some intermediate point C, there will be a voltage whose magnitude bears the same relation to 110 as the number of turns between B and C is to the total number of turns between A and B. If, therefore, C is a sliding contact, any voltage between 0 and 110 may be obtained by altering the position of C. (If the coil is extended as indicated by the dotted lines, it is possible to obtain voltages higher than 110.) When, therefore, an auto-transformer control is used in an x-ray outfit, connections are made as illustrated in Figure 28. On closing x-ray switch II, 110 (or 220) volts are applied across the auto-transformer; a different voltage, whose magnitude depends on the position of the variable contact C, and is equal to 110 multiplied by the number of turns in BC divided by the number of turns in AB is at once applied to the primary of the high tension transformer, and in the usual way, the induced high

voltage causes a current through the tube circuit.

A comparison of the action of the auto-transformer with the rheostat may be obtained best by imagining again that the resistance of the tube suddenly lowers. In this case, the high tension voltage at once causes a greater tube current; automatically the primary supplies more power (a greater current) while a greater current must also be supplied the auto-transformer. In this case, however, the voltage applied to the *primary* (that is, the voltage between A and B) does *not lower*. Consequently the high tension voltage does not lower, and it is quite possible that the suddenly lowering of tube resistance may result in current values increasing far beyond those safe for the apparatus, with consequent damage. Accordingly, whenever there is danger of the tube resistance lowering (as in the gas bulb), the auto-transformer control is not desirable. It may, however, be used in conjunction with a rheostat. Figure 29, for the original electrotype of which my thanks are due the Victor Electric Corporation, is a photograph of the actual control board of an x-ray unit. On the left may be seen two swinging arm controls, one of which regulates the rheostat, the other an auto-transformer.

In the case of a Coolidge tube, as will be seen later, no sudden lowering of tube resistance is possible, and the auto-transformer may be used with advantage. With it, for any given position of the variable contact C, a constant voltage is applied to the primary of the high tension transformer. The high tension voltage, therefore, has a constant value, an important consideration where x-rays are used for treatment. In the case of the auto-transformer, moreover, there is not the loss of power noted above in the use of a rheostat. Finally, to quote from literature of the General Electric Company, Schenectady, N. Y., "in diagnostic work, it has been found that it is almost impossible to obtain duplication of results when a series resistance control is employed for this purpose. We recommend that an auto-transformer be used for control for all diagnostic work and resistance control for therapeutic work." (This remark refers to the Coolidge tube.)

Circuit Breaker.

25. This is a device added so that the circuit may be automatically broken should, for any reason, the current strength (the load) exceed the capacity of the outfit. This might happen, for example, in the case of a gas tube and auto-transformer control, or again because of the accidental short-circuiting of the high tension circuit. The principle underlying the use of many circuit breakers is briefly the following. In the circuit is placed an electromagnet which exerts an attraction on a piece of soft iron near it. When the current exceeds a certain strength, the attraction is sufficient to move the soft iron and so cause the opening of a switch in mechanical connection with it.

Rotary Converter: Motor Generator

26. From the description of the interrupterless transformer which has been given, it should be evident that an alternating current is necessary. Supposing only a supply of direct current is available, what then? In that case, some kind of additional apparatus for obtaining alternating current is necessary. One may use a *motor-generator set*, that is, a combination of a motor, in this case to run on D. C. (direct current) and a generator which is rotated by the motor and "generates" the desired A. C. One may also use a *rotary converter*, which is a single machine by means of which D. C. may be supplied at one side, and A. C. taken off at the other (or vice versa). The general principles of the high tension outfit for D. C. supply, are otherwise the same as described above, except that when a rotary converter is used, a synchronous motor is not necessary. The rectifying disc is turned by the converter at the proper speed, because it supplies the alternating current delivered to the transformer.

27. Another way in which a source of D. C. may be utilized for obtaining high voltages, is found in the use of the induction coil, the second of the two methods noted in Section 11. Although in North America the transformer is used almost to the exclusion of the coil, the latter is by no means obsolete, and a detailed consideration of the principle underlying its construction and use is desirable.

III.

The Induction Coil.

28. In the coil, as in the transformer, the principle of electro-magnetic induction is utilized. Indeed the induction coil is a modified form of transformer. A direct current flowing through a primary coil wrapped about an iron core is regularly made and broken. The magnetic lines of force, therefore, which traverse the iron core, regularly appear and disappear, and, in consequence, there are induced electro-motive forces (E.M.F.) in a secondary coil wrapped over the primary. On "make" of the primary current the induced high voltage is in one sense, on "break" in the opposite. By making the number of turns of the secondary many times greater than that of the primary, very high voltages may be obtained just as in the case of the transformer.

29. To make and break the current regularly what is called an *interrupter* is used. There are three types of these in general use (a) the hammer, (b) the mercury jet, (c) the electrolytic or Wehnelt. Some details in connection with each of these will be noted. First of all, however, the action of the coil will be discussed with reference to one fitted with a hammer break, the kind in general use on small coils. Figure 30 represents a primary coil wrapped about a bundle of iron rods which constitute the (open) core of this type of transformer. The coil is supplied with current from some D. C. source (such as a number of storage batteries, or, in the case of large coils, the supply terminals joined to a direct current generator), connections being made as shown

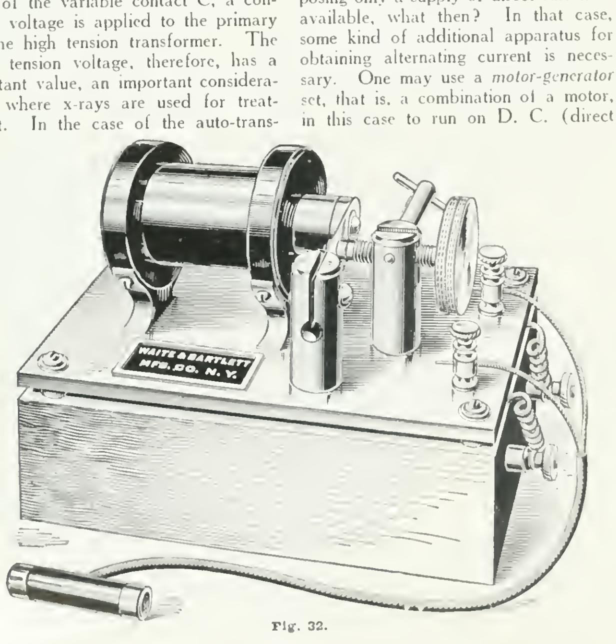

Fig. 32.

in the diagram. P represents a contact point made of a metal such at platinum, attached to the end of a screw passing through a rigid support D. H is a piece of soft iron (the hammer) at the end of a steel spring S, the other end of which is rigidly fastened at O. Normally (that is, when no current is flowing) the platinum point P touches a small piece of platinum P′ attached to the spring. Now suppose the switch K is closed. A current then flows because there is a complete circuit from one terminal of the source through the coil to 0 to P′ to P and back to the other terminal of the source. This current magnetizes the iron core, which accordingly attracts the hammer pulling it to the dotted position. This movement of the hammer breaks the contact between P and P′; the current therefore, ceases to flow; the core loses its magnetism; the hammer, being no longer attracted, flies back and in so doing brings the contact points P and P′ together again, and so closes the circuit. The action is then repeated. As long, therefore, as K is left closed, with such a device the primary current is *automatically* made and broken. Hence if a secondary coil is wrapped about the primary, there will be induced in it a high electro-motive force, in one sense on make, in the opposite on break.

30. Now what about the *magnitude* of the high voltage which may be obtained in this way, and in particular, what about the relative magnitude of that obtained on make as compared with break? To understand the answer to these questions, it is necessary to remember that the magnitude of any induced E.M.F. (see Section 5[1]) depends on both the total change in the number of lines linked with the circuit and the time in which the change takes place. By having a strongly magnetized core and many turns in the secondary, therefore, very high voltages may be obtained provided the time of either make or break is very short. Now as a matter of fact in building a good coil, one of the chief aims of the maker is to make the time of break so many times less than that of make, that the induced voltage obtained on make may almost be neglected in comparison with that of break. In other words, a good coil is able to deliver a current which is practically uni-directional through a tube. To explain why the time of break is so much shorter involves a consideration of one or two further points.

Inductance.

31. The effect of having a large inductance in the circuit must be clearly understood. Suppose a simple circuit contains a battery or some D. C. supply and an electro-magnet. When a current is flowing, a large number of magnetic lines are linked with the turns of the electro-magnet, and we say the circuit has a high *inductance*. Practically the inductance is measured by the number of lines linked with the circuit (due regard being taken of the number of turns) when a current of one ampere is flowing through the coil. Consider now what happens during the short time in which the current rises from zero to its final steady value. As the current increases, more and more lines are being introduced and so there is continually a change in the number linked with the turns of the electro-magnet. By the principle of electro-magnetic induction, therefore, there will be an induced E. M. F. in this coil itself. This is a self-induced E. M. F. or better the E. M. F. of inductance. Now the direction of any induced E. M. F. is always such as to oppose the change causing it. In this case, therefore, the effect of inductance is to set up a voltage (E. M. F.) opposed to the applied voltage (of the battery) and in consequence, to cause a delay in the rise of the current to its steady value. In other words, the effect of inductance in a D. C. circuit is to prolong the time it takes for current to rise to its steady value. Similarly, if a circuit containing inductance is broken, during the time in which the current is falling to its zero value, there is continually a change (in this case a decrease) in the number of lines linked with the circuit, and again an E.M.F. due to inductance. Again, the inductance E.M.F. opposes the change and unless the circuit is broken in a special

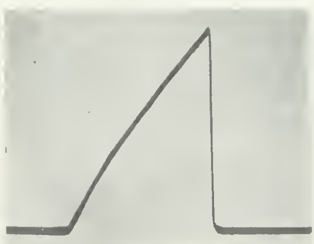

Fig 33

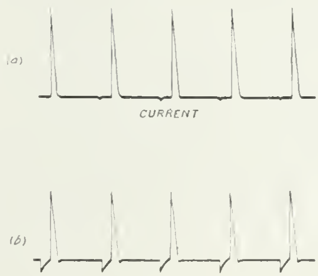

Fig 34 POTENTIAL

way (See Section 33) it prolongs the time of break for the following reason. The actual magnitude of the inductance E. M. F. is generally so great that when a circuit is broken it results in a spark jumping across the gap where the break is made. For a short time, therefore, a conducting path is established at the contacts. Any one who has ever broken a circuit containing an electro-magnet cannot fail to have observed the spark which takes place, on break, at the switch used to break the circuit. *To sum up, then, with a large inductance in a circuit, the time of make is prolonged, while unless special precautions are taken, at break, a spark will jump the break gap and so prolong the time of break.*

Now, obviously, once a circuit is closed, we have no further control over it. The time of rise depends on the amount of inductance and the general arrangement of the circuit. When a circuit is broken, however, the time of break depends on the mechanical means used to break the circuit. If, for example, it is broken by firing a bullet and so breaking a wire (this has actually been done) the time of break is very short, so short indeed, that the two parts where the break occurs are separated so quickly that there is no chance for the spark to jump across.

32. Now let us apply this idea of the last section to the arrangement of Figure 30. In this case the hammer is pulled back by the elasticity of the spring, and the time of break is not short enough to prevent a spark jumping across the contact points. The time of break, therefore (as well as make), is not sufficiently short to give a high voltage, and such an arrangement would be of little use for a practical coil. Moreover, a large percentage of the energy which is stored up in the magnetic field (almost the whole of which in an ideal coil is transformed into the energy of the induced current in the secondary coil) appears in the spark or possibly the arc, which occurs at the contact points.

33. To secure the necessary short time of break, a *condenser* must be placed across the contact points P and P′, as illustrated in Figure 31. The form of condenser used consists of two sets of tin foil, each of many sheets, separated by some dielectric, often paraffined sheets of paper. This arrangement of conductors has what is technically called a high *capacity* (here the word is used in its accurate scientific sense) by which it is meant that, before the potential difference (voltage) between the two sets of plates can rise to values great enough to cause a spark discharge to take place through the paper, an enormous quantity of

electricity must be on each set (positive on one, negative on the other). What, now, is the effect of placing a condenser across the contact points? Briefly it is somewhat as follows: When the switch K is closed, and the primary current begins to rise, a certain quantity of electricity will flow into the condenser, one set of plates becoming positively charged, the other negatively. Consequently the first effect of the condenser is to delay still further the time of make. When the primary current has magnetized the iron core sufficiently, the hammer is attracted and the points separate. Because of the condenser, however (and here we have a second advantage) little sparking occurs at the points, for the E. M. F. of inductance causes a further charging of the condenser. Arcing, therefore, does not prolong the time of break, and for that reason there is much less loss of energy due to this cause. (The energy corresponding to the charging of the condenser is re-gained when the condenser immediately discharges back through the primary coil).

To sum up, then, a condenser lengthens the time of make, shortens the time of break and prevents much of the sparking and arcing at contact points. It is possible, therefore, by using such a device to build up a coil whose high tension voltage on break is enormously greater than on make. There is, however, always some induced voltage at make, and herein lies one of the drawbacks of the coil. Some means must be utilized to get rid of the current due to this reverse or, as it is generally called, inverse voltage. Such means are discussed in the next article.

34. In actual practice, the condenser has to be adjusted to suit the particular primary coil utilized, because the maximum high voltage generated depends greatly on the actual capacity of the condenser. It has been shown, for example, that by changing nothing but the capacity, the maximum potential of a given coil could be changed as much as two and one half times. The same coil, moreover, is not adapted for use under a variety of conditions. To quote from Knox, the eminent English radiologist, "it is far better to have several coils built for special purposes than to endeavor to achieve with one coil the same results under varying conditions of interrupter."

In larger coils operated by means of a hammer break, the interrupter is often on a separate mounting, a small electromagnet being used to attract the hammer. Figure 32 is an illustration of such an interrupter. For the cut of this figure my thanks are due the Waite and Bartlett Company, New York.

FARADIC CURRENTS: FARADISATION

35. Figure 33 is a reproduction of an actual photograph (due to Salomonson) of a record of the primary current during a single make and break. The comparatively slow rise to a maximum followed by a quick drop is clearly shown in the illustration.

If records are made of the current in the secondary (when an x-ray tube is in the circuit) as well as of the secondary voltage, curves somewhat similar to those shown in Figure 34 are obtained. In (b) the fairly large inverse voltage is clearly shown, while in (a) the resulting slight inverse current can be detected. The exact nature of these curves will vary with the conditions and in general they are not quite so simple as those represented in Figure 34. These graphs, however, represent correctly the general nature of what are called *faradic* currents. In so-called *faradisation* use is made of these currents. It will be seen that they are characterized by sudden abrupt changes of current and of potential markedly different from the smooth, gradual changes of sinusoidal currents. The *secondary faradic*, as its name implies, refers to the use of the secondary of a coil. In the *primary faradic* use is made of the E. M. F. of inductance which has been discussed in Section 31. By placing across the contact points leads connected to the patient, on each break, a sudden stimulus is received.

REFERENCES.

1. In the first installment of this series of articles the numbers of sections were not printed. The numbers for the headings of the author's article published in February are as follows:

Section 1.—The Interrupterless Transformer, p. 51.

Sec. 2.—The Volt, p. 51.

Sec. 3.—The Principles of Electromagnetism, p. 52.

Sec. 4.—The Principle of Electromagnetic Induction, p. 53.

Sec. 5.—Magnitude of Induced Voltage, p. 53.

Sec. 6.—Meaning of A. C. Sinusoidal, p. 53.

Sec. 7.—The High Tension Transformer, p. 54.

Sec. 8.—Necessity of Rectification, p. 54.

Sec. 9.—The Synchronous Motor, p. 56.

Sec. 10.—A Simplified Interrupterless Transformer, p. 56.

Sec. 11.—Direction of Current Through the Tube, p. 56.

Sec. 12.—The Polarity Indicator, p. 56.

Sec. 13.—The Foot Switch, p. 57.

Sec. 14—Last paragraph, p. 57.

2. See Standardization Rules of American Institute of Electrical Engineers.

3. Coolidge & Kearsley, Am. J. Roentgenol. 9:77, Feb., 1922.

4. Fortescue & Chubb, Proceedings of Am. Institute of Electrical Engineers, 31:739, 1913.

5. When alternating current is supplied a portion of a circuit containing inductance (See Section 31) the energy depends also on another quantity called the power factor. The amount of energy is still, however, proportional to the product volt-amperes-time.

6. Because of the power factor the current might be much more than 22 amperes.

ERRATA

In addition to the error noted in reference No. 1, above, it should be noted that on page 53 of the February Journal, in the paragraph, "The Principle of Electro-Magnetic Induction," the sentence beginning, "If now the wire A B is moved from" etc., *should read: "If now the wire A B is moved from position I across the lines of force to position II (A' B') a momentary current will be indicated by G, the measuring instrument. If the wire be moved back again a momentary current in the opposite direction is recorded."*

Also in the last line of the first column, p. 53, "A' B'" *should read A B.*

Further, under "Magnitude of Induced Voltage," second column, p. 53, the arabic figure "(1)" *should read* (2).

Bone Tumors: Sarcoma. Periosteal Group. Ossifying Type Benign Ossifying Periostitis and Myositis*

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Case 5.—Pathol. No. 32020.—Benign excessive ossifying periostitis or myositis in amputated stump of femur six years after amputation. Patient of Dr. Baer of Baltimore. (Figures 9 and 10).

Case 6.—Pathol. No. 15283.—Benign excessive ossification of stump after amputation of femur for osteomyelitis (Figure 11).

Case 7.—Pathol. No. 27702.—Excessive bone formation in leg after resection of upper third of fibula for a benign periosteal ossifying growth. Patient of Dr. Le Conte of Philadelphia. (Figures 12, 13, 14 and 15).

Case 8.—Pathol. No. 800.—Benign osteoma or ossifying myositis surrounding the upper third of the humerus. Diagnosed in 1894 ossifying sarcoma. Amputation. (Figures 16, 17, 18 and 19).

OSTEOSARCOMA

I have not had the time to read back as to the original meaning of the term osteo or osteoid sarcoma. I have always been of the opinion that it was first employed to mean a sarcoma arising from bone and not necessarily a bone-forming sarcoma. But, unfortunately, this term has been employed in more recent literature to mean both a tumor arising from bone and a sarcoma containing new bone formation.

OSSIFYING TYPE

Because of the ambiguity of osteo or osteoid sarcoma we need a new term to describe that type of sarcoma in which bone formation predominates, and it seems to me that the word "ossifying" cannot be misunderstood. There is a benign ossifying periostitis and a benign ossifying myositis, and there is also an ossifying sarcoma. The latter, in my experience, has always been periosteal. For this reason I suggest *ossifying sarcoma* to be employed for those periosteal sarcomas in which ossification, both in the x-ray and in the gross and microscopic appearances, predominates in the picture.

CENTRAL SARCOMA

There is a group of bone lesions in which for varying periods there remains an intact bone shell covered with normal periosteum. This bone shell can be seen clearly in the x-ray, and, when one explores the lesion, as I have on many occasions, one finds uninfiltrated normal soft parts, an unthickened periosteum, and this periosteum strips back sometimes exactly like normal periosteum, in other cases it seems looser. The bone beneath may be normal, that is, white and opaque, and when the periosteum is stripped back from each Haversian canal into which the connective tissue of the periosteum dips, a minute drop of blood will appear. The first change from normal in the bone shell is that this bleeding from the Haversian canals is absent, and the bone beneath has lost its white, glistening, opaque appearance and is dark, somewhat like the bark of a tree.

The thickness of the bone shell may vary up to the thinness of parchment. When one palpates the bone shell it may feel like normal bone, it may be slightly rough, or it may give parchment crepitation. In the Journal of Radiology for March, 1920, I discussed and illustrated the types of central lesions. In that article, Figure 1 (Pathol. No. 19133) shows the x-ray of a central myxosarcoma, while Figure 2 (Pathol.

Fig. 1—Pathol. No. 30616. Case 1. X-ray (6/9/22) of periosteal sarcoma of the ossifying type. This bony tumor palpates like bone.

Fig. 2—Pathol. No. 30616. Case 1. X-ray (9/5/22) of periosteal sarcoma of ossifying type. This bony tumor palpates like bone.

*—Received for publication February 3, 1923. (Reprint No. 120).

No. 17871) shows a benign cyst of the greater trochanter. Figure 5 (Pathol. No. 16297) is a benign bone cyst of the upper end of the tibia; Figure 15 (Pathol. No. 22016) a central chondroma of the lower end of the femur, and Figure 16 (Pathol. No. 25778) a central giant-cell tumor of the lower end of the femur, while Figure 20 (Pathol. No. 14229) is a central sarcoma; Figure 28 (Pathol. No. 22929) a central myxoma; Figure 37 (Pathol. No. 23552) illustrates that tuberculosis may appear as a central bone lesion with an intact bone shell. Up to the present time I have never observed syphilis or pyogenic osteomyelitis to appear as a central bone lesion with an intact bone shell without evidence of an ossifying periostitis. The remarkable feature of the central bone lesion as discussed and pictured in the Journal of Radiology for March, 1920, and again in Minnesota Medicine[1] is the absence of any ossifying periostitis in the bone shell about these central lesions, whether they be benign or malignant. It is also true that in multiple myeloma and in metastatic

Fig. 3—Pathol. No. 30616. Case 1. Periosteal sarcoma, ossifying type. Photograph of pieces of bone removed at exploratory excision. For microscopic picture see Figure 4.

carcinoma, especially from a hypernephroma, we may have a central bone lesion with an intact bone shell without evidence of ossifying periostitis.

Fracture in Central Bone Lesions

This may occur in every type of central bone lesion; the fracture may heal with just sufficient ossification for union, but ossification never takes place in the central lesion, except in the bone cyst or ostitis fibrosa.

Why do I discuss the absence of ossifying periostitis in all central bone lesions? Simply to emphasize the contrast with the other types of sarcoma—the periosteal, in which more or less bone formation may be present both in the periosteal growth and in the area of involved shaft.

Types of Periosteal Sarcoma

I have gone over the histories, the x-rays, the gross specimens and microscopic sections of some 240 cases of sarcoma of the periosteal group, and have made, for working purposes the following classification:

(A) Ossifying Type (excessive periosteal bone formation).

(A-1) The shaft beneath the bone formation appears normal.

(A-2) The shaft beneath shows some osteoporosis or destruction.

The number of cases in A-2 predominates, and as a rule the diagnosis of sarcoma can be made from the x-ray only. But sometimes chronic osteomyelitis, syphilis, traumatic periostitis, myositis and exostosis cannot be differentiated from this type of ossifying sarcoma.

In the Journal of Radiology for March, 1920, almost three years ago, I had only one example of the type A-1, the excessively ossifying periosteal sarcoma with an apparently normal shaft. This case is there illustrated in Figure 70 (Pathol. No. 23284) and is reproduced in this article in Figures 7 and 8. This paper now being written is to report and discuss further examples of the A-1 type excessive bone formation.

(B) Sclerosing Type. This form has just been discussed and appears with illustrations in the Journal of Radiology for February, 1923.

In looking at the x-rays, gross specimens and microscopic sections of the sclerosing type of periosteal sarcoma we may recognize three forms, based upon bone formation in the periosteal growth:

(B-1) Little or no periosteal bone formation illustrated by the case reported in the Journal of Radiology for February, 1923; and for March, 1920 (Figs. 65 and 66, Pathol. No. 25761).

(B-2) In this group there is considerable bone formation in the periosteal tumor, illustrated in Figs. 62, 63 and 64 in the Journal of Radiology for March, 1920 (Pathol. No. 15557).

(B-3) Periosteal bone formation about the sclerosing sarcoma of the shaft is excessive. This type is rare and often hard to distinguish from A-2.

(C) Osteoporosis. Destructive Type.

In this group the x-ray of the shaft and the study of the gross specimen show bone destruction. In the early stages it may resemble osteoporosis due to lipomasia of non-use[2]. In the sarcoma of the osteoporosis type only one bone is involved, while in the osteoporosis from fixation and non-use all the bones in the neighborhood of the joint show definite changes. This is the distinguishing feature between the benign and the malignant. I have now in preparation a paper describing this group.

The osteoporosis type of periosteal sarcoma may be subdivided into four groups, based upon the presence or absence of ossification of the periosteal tumor and the presence or absence of definite bone defects in the shaft.

Syphilitic periostitis with shaft involvement and infectious ossifying periostitis may have an x-ray picture very similar to this form of periosteal sarcoma[3].

(D) In this type of periosteal sarcoma there is a definite palpable peri-

Fig. 3-a Pathol. No. 30616. Case 1. Periosteal sarcoma, ossifying type. Photograph of longitudinal section through upper end of femur and tumor after amputation at hip joint. There have been two exploratory operations with partial excision. It is evident that the periosteal growth has increased in size since the x-ray September 5, 1922 (see Fig. 2). The gross picture is that of sarcoma and the marrow is involved with tumor.

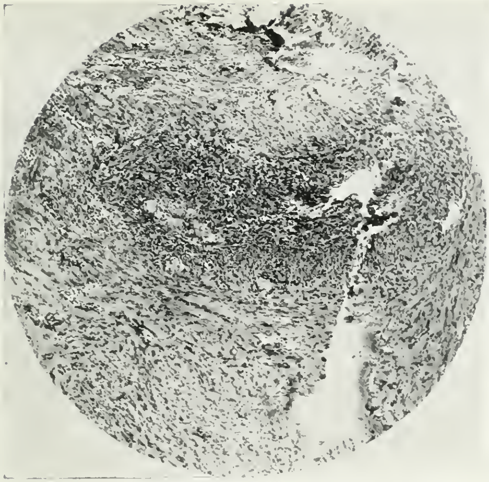

Fig. 4—Pathol. No. 30616. Case 1. Periosteal sarcoma, ossifying type. Microphotograph, low power, of infiltrated muscle outside of periosteal growth. For gross see Figure 3, for x-rays see Figures 1 and 2.

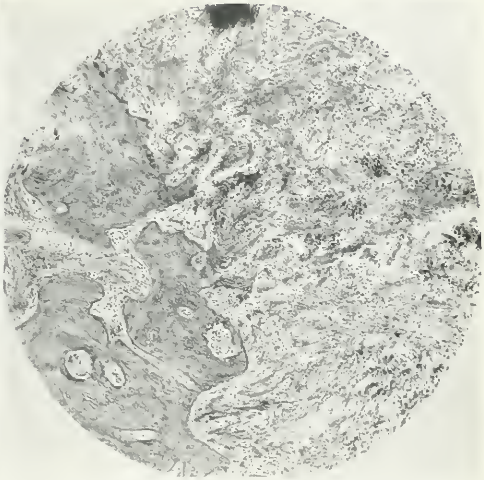

Fig. 4-a—Pathol. No. 30616. Case 1. Peritoneal sarcoma ossifying type. Microphotograph, low power, showing new bone formation to the left and sarcoma infiltrating muscle to the right.

osteal tumor, but the x-ray shows no bone formation. In some instances the shaft beneath the periosteal growth is normal and the differentiation from a sarcoma of the soft parts is impossible. In a few cases there are multiple marrow shadows due to tumor tissue, but no evident destruction of the cortical bone[4]. In other cases there is superficial destruction of the cortical layer of the shaft. The illustrations in the Journal of Radiology for March, 1920, picturing the different types of periosteal sarcoma should be compared with those in the number for August, 1922, of infectious ossifying periostitis.

This group D will be further discussed in another article.

I am not at all sure that this classification will ultimately be accepted, but up to the present time in a restudy of some 240 cases of periosteal sarcoma, the majority of the cases from a study of the x-ray and the gross specimen, can be easily placed in one of these four groups.

There seems to be evidence that a periosteal sarcoma may show definite changes as the period of the disease increases in length and the variations are in the ossification of the periosteal tumor and in the sclerosing or destruction of the shaft. So that one case may change from one group to another.

The object, however, of this classification is an attempt to ascertain, if possible, some more accurate method of differentiating the benign from the malignant in the early stage of the disease. The longer periosteal sarcoma is present the less difficult, as a rule, the diagnosis.

CASES 1 TO 8

CASE 1—(Pathol. No. 30616)—Periosteal sarcoma, ossifying type of shaft of femur below trochanters. (Figs. 1 and 2, x-rays; Fig. 3, gross specimen; Fig. 4, microscopic).

W. B. L., white male, aged 20, was referred to me by Dr. Frank D. Dickson and Dr. W. W. Duke of Kansas City, Mo., in June, 1922. I examined the x-ray pictures and the patient in Chicago.

In brief, the x-ray pictures resembled periosteal sarcoma of the ossifying type more than the benign ossifying periostitis, but the lesion palpated like bone. Up to that time I had never observed an ossifying periosteal sarcoma which palpated like an exostosis or a benign growth of periosteal bone. In all the previous cases of periosteal ossifying sarcoma the palpable tumor was larger than the ossifying tumor in the x-ray, and I could palpate a soft-part tumor on top of the bone formation.

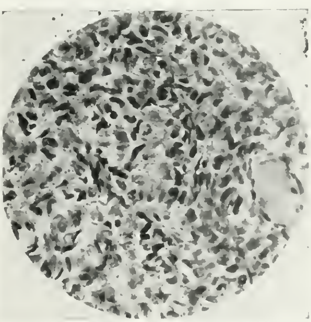

Fig. 5—Pathol. No. 30616. Case 1.—Periosteal sarcoma ossifying type. Microphotograph. High power. Tissue outside of bone filled with typical sarcoma cells, osteogenic type.

I now know that the excessive ossifying periosteal sarcoma may, in rare instances, palpate like the benign exostosis or ossifying periostitis.

In this patient, aged 20 years, there had been intermittent pain, shooting up and down the right thigh for two years, and the palpable mass of bone for two years. In addition, there had been a dull ache in the tumor area. There had been a slight loss of weight. Every other examination was negative, and up to the time of the operation every other examination had continued negative.

The duration of pain and the palpable bony growth of two years without evidence of metastasis to the lungs and without evidence of bone destruction of the shaft and with no very marked increase in the growth of the periosteal bone, favored a benign lesion.

In the Journal of Radiology for March, 1920, when I reported 70 cases of periosteal sarcoma, it was noted that only six patients lived two or more years without evidence of metastasis.

X-rays in Case 1: Figures 1 and 2 are x-rays of the upper third of the right femur taken June 9, 1922. The most marked feature is an ossifying periosteal tumor below the intertrochanteric line, larger on the outer side. The new growth of bone seems to surround the shaft in spite of which, however, we can see shining through the almost normal marrow shadow and what appears to be an almost unbroken cortical

shadow. The evidence suggestive of sarcoma is that the new growth of bone encircles the shaft and the little isolated islands of bone a few millimeters distant from the outside, the main, shadow of the bone.

I have gone over the x-ray pictures of about 100 cases of benign oxostoses and different types of benign ossifying periostitis. With the rarest exceptions does the new growth of bone encircle the shaft. The little isolated areas of bone formation may be present in the benign lesions.

Advice given in this case: I wrote that the x-ray suggested sarcoma, but the mass of bone palpated like a benign lesion. Up to the present time we have never cured a sarcoma by amputation situated above the middle third of the femur. Resection with bone transplantation of the fibula would be possible in this case. Dr. McClure, surgeon to the Ford Hospital in Detroit performed this some months ago with a very good functional result.

I therefore advised intensive x-ray treatment, which was given by Dr. Skinner of Kansas City.

X-ray Diagnosis by Dr. Phemister of Chicago: I showed these x-rays to Dr. Phemister in November, 1922. He expressed the opinion that it was a periosteal ossifying sarcoma. This opinion was based on the spindle-shaped enlargement of the ossifying area, the radiating area of bony tuberculae about

Fig. 6—Pathol. No. 29638. Case 3. Benign ossifying tumor of neck of femur. Tumor palpates like bone. No operation.

the periphery, the apparent invasion of the marrow canal.

X-ray Treatment: This had no apparent effect on the size of the palpable mass, nor did the x-ray show any changes. The pain increased so that it was necessary to give the patient morphine. X-rays of the chest were negative for metastasis. The x-rays of other bones were negative. All other examinations were negative.

First Exploratory Operation: Dr. Dickson, November, 1922, five months after the first examination and two years and five months after the onset. The indication for the operation was the intense pain, and no definite improvement in the x-ray picture. At the exploratory incision. Dr. Dickson wrote there was no infiltration of the soft parts; the mass of bone was hard and well defined, too hard to remove with the cautery, so that a piece of bone was removed with the chisel and mallet; no soft bone was found.

Gross and Microscopic Study of First Piece Removed: The specimen consisted of firm bone resembling the involucrum of osteomyelitis. Sections of this showed new bone formation with no evidence of sarcoma. Dr. Phemister saw these sections and was unable to find any histological picture of sarcoma.

Second Exploratory Operation: Dr. Dickson, December, 1922. This was indicated because the patient continued to have more pain, requiring morphine for relief. At this operation posteriorly definite infiltration of the muscle was found.

At this second operation the tumor mass was exposed posteriorly, and it appeared more extensive than the x-ray would indicate. The posterior portion of bone was less dense than the anterior and came off in flake-like masses; there seemed to be infiltration of the muscle beyond. Portions of bone and soft parts were removed.

Fig. 7—Pathol. No. 23284. Case 4. Excessively ossifying periosteal sarcoma in old myositis. At X is the shadow of the old tumor of twenty years' duration.

Fig. 8—Pathol. No. 23284. Case 4.—Excessively ossifying periosteal sarcoma; possibly sarcoma in old ossifying myositis.

Fig. 9—Pathol. No. 32020. Case 5.—Benign excessively ossifying periostitis, or ossifying myositis. Stump six years after amputation.

It is important to note that at both operations, after removing bone, the exposed tissues were burnt with the electric cautery.

Gross Pathology: Figure 3 shows the particles of bone received. Attached to the piece of bone marked "4" is a bit of muscle.

Frozen Sections: (Fig. 4). In the muscle outside the bone a definite picture of sarcoma was found. The chief type of cell was spindle, and there was a great deal of eosin-staining intercellular substance. It resembled, therefore, sclerosing sarcoma. In other places we could see new bone formation without osteoblasts, indicating that the tumor cells were forming bone.

Hip-joint amputation was advised. This has been done. The patient is doing well. The gross specimen has not yet been received.

Pathological Fracture: Dr. Dickson wrote December 30, 1922, that after the second exploratory operation, at which he removed considerable bone, he left a bridge of bone anteriorly. This fractured, and as the boy was having considerable pain, he performed a hip-joint amputation December 29th.

He also wrote that at the second exploratory operation and at the examination of the specimen after amputation there was no evidence of extension of the process.

Remarks on Case 1: All of us, except Dr. Phemister, who was quite positive from the x-ray that it was sarcoma, were rather inclined to the view that it might be a benign ossifying tumor. This was based more upon palpation than upon the x-ray picture alone.

It is natural to ask the question whether in the benign ossifying lesion there could be as much pain as in this case. The pain increased. There is no evidence that the x-ray treatment increased the pain; it did not relieve it. I am rather inclined to the view that when we study our benign ossifying lesions of bone we will find that, in some of these, pain of this type may be present, and I will report a case of this kind here. (Case 5—Pathol. No. 32020).

CASE 2—(Pathol. No. 32122)—Excessive ossifying periosteal sarcoma of upper end of tibia; metastasis to lungs with ossification of the metastatic tumor in the lung. This case was reported[5] by Dr. E. R. Le Count, Professor of Pathology of Rush Medical College.

This contribution of Le Count on pleural and pulmonary secondary osteosarcomas covers the literature from the contribution of Virchow in 1864 to 1909. In addition to reporting an example of this excessively ossifying periosteal sarcoma, he conclusively proves that the metastatic tumor from bone sarcoma may show ossification.

Dr. Phemister of Chicago has interested himself in the types of bone formation in sarcoma of bone, and he is inclined to the opinion and seems to have proved it, that sarcoma cells may produce new bone in both the primary and metastatic tumor, and he seems to have had a larger experience than any of us in this type of excessive ossifying periosteal sarcoma. I trust he will publish the results of his studies.

CASE 3—(Pathol. No. 29638)—*Benign ossifying periosteal tumor of the neck of the femur.* (Fig. 6).

Figure 6 is an x-ray sent me by Dr. John A. Talbott of Washington, D. C., February 14, 1922. Both of us were inclined to the opinion that the lesion was benign and probably of the exostosis type. Operation was advised against. The patient was a colored male aged 30 years, an ex-soldier. His occupation before the war was that of a plasterer. While in the army several years ago he received a severe blow with a trench shovel in the region of the involved bone. There was pain and disability for a few days. Then an interval of freedom; then recurrence of pain with slight stiffness. The x-ray is shown in Figure 6. The examination showed some limitation of rotation and abduction and slight flexion. A bone-like mass could be palpated posterior and medial to the great trochanter, and there was a visible tumor in the gluteal region on the left side. Other examinations were negative. A stereoscopic plate showed that the bony growth did not encircle the neck. The man's disability was slight. It is now one year since this x-ray was taken and no change has been observed.

In the x-ray one observes that the outline of the new growth of bone is sharp and there are no shadows of islands of bone outside the main tumor, and no evidence of bone destruction

Fig. 10—Pathol. No. 32020. Case 5. Benign excessively ossifying periostitis or myositis. Longitudinal section through amputated stump. Note the normal marrow in shaft surrounded by a new growth of bone. At X an island of bone in muscle; at Y an osteophyte growing into muscle.

Fig. 11—Pathol. No. 15283. Case 6. Benign excessive ossifying periostitis or myositis in stump after amputation of femur for osteomyelitis. This bone formation has since disappeared.

Fig. 11a—Pathol. No. 15283. Case 6. X-ray of stump six years later showing ossifying myositis has disappeared.

can be seen in the neck of the femur.

CASE 4—(Pathol. No. 23284)—Excessively ossifying periosteal sarcoma; possibly sarcoma in old ossifying myositis. Death, with symptoms of metastasis to lungs. Operation and autopsy refused. (Figs. 7 and 8).

This case has previously been reported in the Journal of Radiology for March, 1920 (Fig. 70). At that time it was my only example of the periosteal sarcoma with excessive bone formation.

Clinical Note: I saw this patient in June, 1918. She was referred to me by Dr. Edward P. Shelby of New York. The patient was a white female, aged 38 years, who had increasing pain and tumor around the lower shaft of the femur of two years duration following a trauma. When we went into the history more carefully, we ascertained that she had been a continuous horse-back rider from youth, and twenty-four years ago, at the age of 14 she had observed a painless hard mass in the adductors above the internal condyle of the right knee. This mass remained quiescent twenty-two years; no x-ray had been taken. Then, two years ago, there was the trauma with increasing pain and a gradual development of a larger bony mass surrounding the lower third of the femur.

The lateral x-ray (Fig. 7) shows a light, round shadow at "X" which suggests an old myositis of the rider's bone type. But now, surrounding the lower shaft of the femur there is an excessive growth of new bone, most marked posteriorly, and when we study the shadow of this new bone formation in the lateral view (Fig. 7) and in the antero-posterior view (Fig. 8) we find no positive evidence of destruction of the shaft, and the bone formation on the shaft in the inner zone is that of a benign ossifying growth. But the periphery has fine spicules of bone extending into the soft parts, which is suggestive of sarcoma.

However, this picture may be seen in ossifying myositis.

Figure 7 was taken in November, 1917, and Figure 8 in June, 1918. If pictures were taken after these dates, I was not informed.

A number of surgeons and roentgenologists saw these x-rays, and all of them considered the possibility of an old ossifying myositis, as well as the question of a secondary sarcoma. In 1918 the x-ray of the chest was negative. The patient refused amputation, and at that time I advised against an exploratory incision, as I could not conceive of its value if the patient refused the indicated amputation, should the section show sarcoma.

The patient continued to suffer pain and then began to lose strength and flesh. She died in May, 1920, with symptoms of metastasis to the lungs.

Remarks on Case 4: It is difficult to explain the death of this patient except on the diagnosis of a sarcoma with metastasis to the lung. It still represents the largest ossifying periosteal tumor in my group of 240 cases.

CASE 5—(Pathol. No. 32020)—Benign excessively ossifying periostitis or myositis about the femur in an amputated stump six years after amputation. Patient of Dr. Wm. S. Baer of Baltimore.

Fig 12—Pathol. No. 27702. Case 7. Benign osteofibroma, periosteal, in upper end of fibula. Operation—resection. See Figure 13 for result.
Fig 13—Pathol. No. 27702. Case 7.

Excessive bone formation after resection of the fibula for primary lesion shown in Figure 12. X-ray one year and four months after operation.

Figure 9 is the x-ray of the amputated stump. This new bone formation could be palpated directly beneath the skin, at the end of the stump and everywhere the bony tumor could be palpated without any evidence of infiltration of the soft parts. Figure 10 is a photograph of a longitudinal section through the femur and bony growth. The femur is practically uninvolved; the marrow tissue is normal; the bony growth can be separated from the shaft of the femur, and the bone beneath is smooth, but there is no periosteum. The growth of bone is, therefore, outside the periosteum and infiltrates the muscle. In the rectus muscle, at "X" there is an isolated piece of bone.

Careful microscopic study of numerous sections shows no evidence of sarcoma; numerous osteoblasts are present about the bone lamellae. Between the bone there is inflammatory tissue. The patient is in good general health without evidence of metastasis to the lungs.

Clinical Note: Six years and seven months ago this adult woman was operated on by Dr. Baer at the Union Protestant Hospital, and the thigh was amputated in the middle third. At that time, in 1916,, pieces of bone were sent to the laboratory, and are recorded under Pathol. No. 19358. The gross and microscopic study at that time recorded the diagnosis of a benign osteoma, apparently growing from the lower end of the femur. I have restudied both the gross specimen and the sections and can find no evidence of sarcoma. When the bone pieces are placed together we get the impression of a pedunculated tumor, and in the sections we find cartilage on top of cancellous bone. This is a picture only found in the benign exostosis. Up to the present time we have not yet received from Dr. Baer a complete history of the orignal lesion.

Ultimate Result: A number of letters from the patient to Dr. Baer are filed with the pathological report. Apparently she suffered from a painful stump, and was unable to wear her artificial leg very much. A letter dated 1917 still complained of a painful stump and inability to wear the artificial limb. In June, 1922, about six months before her readmission, she informed us that she was free from pain from February, 1920, to February, 1921, and then the pain returned.

Clinical Note on Readmission in January, 1923: The patient is now 46 years of age. Some sixteen years ago, ten years before the amputation, her knee was injured by a polo ball.

About one year before her admission to Union Protestant Hospital, in 1916, the knee became swollen and stiff. Apparently the first operation at the hospital was the removal of the bony tumor, which I have described, and then ten days later, the amputation. The exact duration of the palpable bony mass in the stump is not given in the history.

Remarks on Case 5: The long interval between the first amputation and the second is evidence against malignant disease. Nevertheless, the bone formation in the stump is unusual and very excessive. As a rule ossifying myositis follows immediately after the trauma, reaches its height and then gradually recedes. I have only one example of an ossification in a stump similar to this (See Case 6). Here the bone formation was immediate and then receded and has now almost disappeared.

CASE 6—(Pathol. No. 15283)—Benign excessive ossification in end of stump after amputation of femur for osteomyelitis. The x-ray (Fig. 11), shows a very large amount of bone formation in the stump beneath the end of the femur, and the two silver plates used in the previous operation after the fixation of a fracture. The amputation was performed because of infection and osteomyelitis.

Clinical Note: This adult male came under my observation some ten years ago. There was a fracture of the shaft of the femur below the trochanter with overriding and non-union. The operation for reduction and plating was a very difficult one, due to excessive callus. There was first a low-grade infection of the soft-part wound, then a secondary osteomyelitis, then a general septicemia. The amputation was rapidly performed to prevent death from general infection. This bone formation took place within six weeks in a wound healing by granulation. Nothing was done, except removal of the plates. Within the two years most of the bone formation has disappeared (Fig. 11-A), and the patient has been able to wear an artificial leg with comfort.

CASE 7—(Pathol. No. 27702)—Benign (?) excessive bone formation after resection of the upper third of the fibula for a benign periosteal ossifying growth. Figure 12 is an x-ray of tumor of fibula before resection. Figure 13, one year and four months after resection, shows ossification, and Figures 14 and 15 show excessive ossification of the upper half of the leg three years after operation.

Clinical Note: This was a white female, aged 22 years, a patient of Dr. R. G. Le Conte of Philadelphia. There has been no history of trauma, but there had been observed in the region of the upper end of the fibula a painless bony growth for some years. The tumor palpated like bone, similar to Case 1 in this paper. The x-ray (Fig. 12) shows a growth of bone surrounding the upper third and the head of the fibula. The shaft of the fibula, apparently unchanged, is seen shining through the surrounding bony growth. The outlines of the ossifying periosteal tumor are very distinct and islands of bone outside the tumor area observed in Case 1 (Figs. 1 and 2) are not seen in this case. The clinical picture, the palpation and the x-ray all indicate a benign periosteal ossifying lesion.

Operation, November, 1919, Dr. Le Conte: Dr. Le Conte informs me that in removing the tumor he cut through muscle beyond the tumor and sawed the fibula below the tumor. The external nerve was dissected out of a groove, but he did not think he exposed tumor tissue. The tumor rested upon the tibia like a saddle, and in this part of the operation the tumor had to be broken off the tibia, but there was no evidence of bony connection and perhaps in doing this the periosteum of the tibia was stripped.

Microscopic Study: The tumor is an osteofibroma, that is, between the islands of bone there is fibrous tissue with no cellular areas suggesting sarcoma; nor was I able to find any evidence of myxoma or chondroma. The muscle outside of the tumor shows myositis. Although in the x-ray the tumor appears to be chiefly bone, in the gross and in the sections it is largely fibroma.

X-ray Result: March, 1921, one year and four months after operation (Fig. 13). We observe that in the defect after removal of the upper end of the fibula there is the shadow of a new growth of bone; it extends down the shaft of the upper end of the remaining portion of the fibula and overlaps the upper third of the tibia. This area palpates like bone. There is no tenderness.

At this time Dr. Le Conte and Dr. Lee discussed the possibilities. We were all rather inclined to the view that it was a benign growth of bone due to the ossification of a postoperative hematoma, or to the stripping of the periosteum of the tibia, and further operation was decided against. Apparently there is no doubt that the traumatic ossi-

Fig. 14—Pathol. No. 27702. Case 7. X-ray. 1 12/1923. Benign (?) excessive bone formation three years after resection of the upper end of the fibula for tumor shown in Figure 12.

Fig. 15—Pathol. No. 27702. Case 7. X-ray, 1 12/1923. Benign (?) excessive bone formation three years after resection of the upper end of the fibula for tumor shown in Figure 12.

fying periostitis and ossifying myositis are better left alone.

The entire object of this paper is an attempt to differentiate these benign ossifying lesions from the ossifying sarcoma.

X-ray October 11, 1922: The interval is now almost three years since the resection and almost two years since the last x-ray. On palpation there is a growth of bone extending from the knee-joint to the junction of the middle and lower third of the leg. The bone surrounds the shafts of the fibula and tibia.

X-ray January 12, 1923: These x-rays are reproduced (Figs. 14 and 15). The increase in bone formation since October is very slight. In the lateral and antero-posterior views the bone formation more resembles ossifying myositis than any well known ossifying lesion, but this should be compared with the x-ray in Case 4 (Figs. 7 and 8), which has been diagnosed ossifying sarcoma, because the patient died of metastasis.

This patient in Case 7 is in perfect health, the x-rays of the chest show no metastasis; she is suffering no pain. It is important to note that in Case 1 and in Case 4, both sarcomas, pain was a prominent symptom, and in Case 5 the excessive ossification of an amputation stump, pain was also a prominent symptom. In Dr. Le Conte's patient there is no difficulty in walking, but flexion in the knee-joint is somewhat restricted.

Remarks on Case 7: Were it not for the evidence of sarcoma in the ossifying growth in Case 1 and the probable

Fig. 16—Pathol. No. 800. Case 8. Benign osteoma, or ossifying myositis of upper end of humerus. Photograph of patient before operation in 1894.

sarcoma in Case 4, I would be inclined to the view that in this case of Dr. Le Conte the ossifying growth is benign. The microscopic evidence in Case 5, Dr. Baer's case, excessive ossification of the stump, indicates that it is benign.

From my study of the situation up to date it seems to me that the only treatment in Le Conte's case is what Dr. Baer used in his—amputation. In Dr. Baer's patient the excessive bone formation was only apparent many years after amputation, in Le Conte's case it was gradual since November, 1919, three years ago. We have, therefore, no evidence that this excessive bone formation will cease, and we must also bear in mind the possibility of sarcoma. In Baer's case the stump was useless for an artificial limb, in Dr. Le Conte's patient, if bone formation continues, there will be greater loss of function at the knee-joint.

Cases of this kind show the importance of a restudy of the possibilities of excessive bone formation, both benign and malignant. I have gone over all the cases of exostoses or benign ossifying tumors subjected to operation, and, although in some there has been reformation of bone, in none has it been as excessive as in Le Conte's case; it usually appeared directly after operation and then gradually receded.

In the restudy of the cases of ossifying myositis the same is true—rapid formation of bone after trauma and then, after a short time, recession.

These two stumps, Baer's and mine, are the only two showing excessive bone formation. In mine it appeared immediately and then receded, in Baer's case it appeared late and was progressive.

CASE 8—(Pathol. No. 800)—Benign osteoma or ossifying myositis surrounding the upper third of the humerus. Diagnosed in 1894 ossifying sarcoma. Amputation at the shoulder-joint. Death eight years later with symptoms of obstruction of the esophagus (Figs. 16, 17, 18 and 19).

Fig. 17—Pathol. No. 800. Case 8. Benign osteoma or ossifying myositis of upper third of humerus. Photograph of surface of dried specimen.

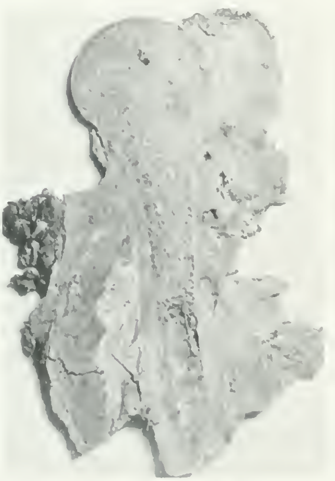

Fig. 18—Pathol. No. 800. Case 8. Benign osteoma or ossifying myositis of upper third of humerus. Photograph of longitudinal section through shaft of humerus and surrounding bone tumor and infiltrated muscle.

Fig. 19—Pathol. No. 800. Case 8. Benign osteoma or ossifying myositis of upper third of humerus. X-ray of specimen shown in Figure 17.

Clinical Note: This patient was referred to Johns Hopkins Hospital by Dr. Reed White of Lexington, Va., in 1894. He was a white male, aged 30, a farmer. Some eighteen months before there had been a trauma followed by pain and a gradual swelling of the upper third of the arm. The uniform, irregular swelling is shown in Figure 16. My note made at that time reads as follows: Uniform swelling; tumor, hard like bone; surface, irregular; some restriction of motion at the shoulder-joint. Dr. Halsted then was of the opinion that it was an ossifying sarcoma and asked me to perform the amputation. The gross specimen and sections are still preserved in the laboratory, now 29 years since the operation, and old and new sections have been repeatedly studied without finding any areas of sarcoma. The surface of the gross specimen with its irregular outgrowths of bone is shown in Figure 17; the longitudinal section in Figure 18. The marrow cavity of the humerus is normal; the inner cortical bone is normal; in the outer cortical bone there are cavities; the new growth of bone springs from the shaft and extends out into the muscle. The base is eburnated and the outer portion of the bone more porous. In both types of bone there are cavity formations which resemble the marrow cavity. The sections show new growth of bone, and in the larger cavities between the bones fatty tissue, in the smaller areas between bones fibrous tissue.

Remarks on Case 8: I have always looked on this case as an example of benign excessive ossification. Yet it is possible that the late death (eight years later) may have been due to metastasis to the lung with pressure on the esophagus. Dr. Phemister informs me that in one of his cases of ossifying sarcoma death from metastasis to the lung did not take place until seven years after amputation.

Figure 18 is an x-ray of the specimen.

Conclusions

This paper is but an introduction to this study. In subsequent papers I propose to report on ossifying myositis, the different types of ossifying periostitis and exostoses with an attempt to get at evidence of how we can recognize the excessive ossifying sarcoma.

These cases and this subject have just been presented to the Eastern Section of the American Roentgen Ray Society at their meeting in Atlantic City, January 26, 1923.

The discussion demonstrated that the ossifying type of periosteal sarcoma resembling Case 1 is a rare occurrence. That excessive ossification of the stump as in Baer's Case 5 and in mine, Case 6, is almost unique.

Also the excessive ossification after resection of the end of fibula, Case 7, patient of Le Conte, has apparently never been observed before. Dr. David B. Bowen of Philadelphia who took and studied the x-rays in Le Conte's case, was rather inclined to the diagnosis of malignancy and to immediate amputation.

A second paper will be published on this group, in which will be included the observations of bone formation after x-ray treatment of periosteal sarcoma.

The entire problem of bone formation associated with benign and malignant lesions of bone demands further investigation.

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Relative Value of X-Ray Evidence in the Diagnosis of Duodenal Ulcer

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NOT many years ago ulcer of the duodenum was thought to be a rather rare condition, far overshadowed in importance by gastric ulcer. Final recognition of the fact that the contrary is the case was brought about very largely by the efforts of the roentgenologist. From the first broad clinical study of this condition, therefore, the evidence obtained from the roentgen ray examination was accorded first place in its diagnosis. However, since it is always rather dangerous to become too well satisfied with one's own conclusions, and since the specialist has always been subject to adverse criticism on the ground of his restricted viewpoint, it has seemed worth while to analyze a small series of duodenal ulcer cases which have been studied not only by x-rays methods, but with regard to the chemistry of the gastric contents, the history and the physical findings. In these cases the various investigations mentioned were made all at the same time and by the same organization. The patients have been carefully followed up and are still nearly all under supervision. It should be pointed out that there has been no surgical confirmation of the diagnosis in any of them for the reason that they were all uncomplicated cases of the type which yield rather readily to medical measures. It may perhaps be considered that the uniformly prompt and decided response to dietary and alkaline therapy has in itself constituted a confirmation of the diagnosis.

Routinely, an exhaustive history has been taken and a physical examination made on the day before the laboratory phases of the investigation were begun. If, then, either of these preliminary measures cast suspicion upon the gastrointestinal tract subsequent work was started by fractional analysis of the gastric contents, followed by x-ray examination of the entire gastro-intestinal tract including the gall bladder. Complete routine blood examinations including the Wassermann test, and complete urine examination, were, of course, made in all cases. If, following these investigations, the diagnostic picture was still incomplete, further work was done in following up any special angles which may have suggested themselves.

For this analysis only forty cases were used. This number of recent clear-cut duodenal ulcer cases still under observation, and with complete records embodying the features outlined, was available, and it was thought preferable to make a close study of a comparatively small number rather than to include a larger mass of material which was in some particular incomplete or obscure.

The typical ulcer history is often considered in itself almost sufficient evidence for a diagnosis. It is interesting to note that such a history including recurring attacks of digestive disturbance, characterized by hunger pain coming on from two to three hours after food, and relieved by swallowing food or alkalies, was obtained in only 45 per cent of these cases. In 20 per cent, very careful questioning, often repeated in the form of leading questions after the examination, failed to uncover any historical evidence at all suggestive of ulcer. In two of the pa-

*—Read at the Annuual Meeting of the Radiological Society of North America at Detroit, Dec. 6, 1922

tients, sudden and severe hemorrhage had been the only symptom prior to examination. Thirty-five per cent were not typical in history, but were suggestive, in that the history mentioned a more or less prolonged period of atypical dyspepsia. On the other hand, we have not infrequently had quite conclusive ulcer histories from patients, who on close examination, failed to show anything more than hyperchlorhydria.

Physical examination is not expected to give a great deal of information with regard to duodenal ulcer unaccompanied by obstruction or malignant change. Epigastric tenderness and rigidity or muscle guarding are the only objective signs we have found in any considerable proportion of these cases, and they are, of course, not at all peculiar to this condition. Both were entirely absent in 30 per cent of the cases studied. A point of tenderness overlying the shadow of the duodenum, when palpation was guided by fluoroscopy, was found present in about the same percentage of cases as epigastric tenderness during the original physical examination.

Analysis of gastric contents was done routinely by the fractional method. The small Rehfuss or Lyon's tube was given the patient to swallow before food was taken in the morning. The gastric residuum was recovered and the usual Ewald test meal given without removing the tube. Specimens were then withdrawn every fifteen minutes until the stomach was empty or until two and one-half hours had elapsed. These specimens were titrated for free and combined acid and the usual graphic curve constructed. Each specimen was also tested for occult blood. As pointed out by Crane before this society last year, the two types of acid curve most typical of ulcer are the one which starts high and remains high throughout the digestive period, and the one which, while starting out at a normal point or a low point, constantly ascends, remaining at or near its high level when the stomach is empty. We found one of these two types in $37\frac{1}{2}$ per cent of these cases—however, the remainder show either an acid curve which was in all respects normal and was going down rapidly at the end of the digestive period, or even a sub-acid curve with all the figures below normal. This latter condition was obtained in 25 per cent. We did not encounter achylia in this series, although a few cases showed complete anacidity at the end of the first hour and would have been listed as cases of achylia under the one hour Ewald meal technique. There was one feature consistently present in all these analyses—namely, the clean character of digestion, there being uniformly a minimum of gastric mucus, and complete absence of pus.

As previously stated, all gastric fractions were tested for occult blood and the feces were likewise so tested. We found occult blood in one or more fractions in only 20 per cent of the cases here reported. Blood was found in the stool after the omission of meat from the diet in only five cases. In a number of patients the tube was allowed to pass into the duodenum for the gall-bladder drainage procedure described by Lyons and others. While we recovered microscopic or chemical blood with the duodenal return in many of these cases, it was so inconstant a finding that we attach no significance to it if absent. As an independent test, we do not feel that it would be worth doing for any information it might afford in regard to the presence or absence of ulcer in the duodenum. We have not used the silk cord test to investigate the presence or absence of bleeding in the duodenum.

From the roentgen standpoint 80 per cent of the cases gave direct evidence of duodenal ulcer in the presence of the typical persistent cap deformity of the type recognized as being associated with this condition. In the remainder the evidence was indirect and consisted of failure to fill a normal cap in spite of postural and palpatory efforts as well as hypertonus, hyperperistalsis and hypermotility. In no case have we been able to make a diagnosis of duodenal ulcer without one of these two sorts of x-ray evidence. All patients not showing a definitiely normal gastro-intestinal tract on the first x-ray examination were re-examined after atropin or belladona had been given to physiologic effect. This re-examination has frequently sufficed to rule out cases which from our initial observation would have been considered distinctly pathological. It is a somewhat time consuming precaution, but has saved us not a few embarrassing mistakes.

Briefly, we have found direct x-ray evidence of duodenal ulcer in 80 per cent; indirect x-ray evidenc in 20 per cent. Of the objective evidence, all of that obtained from the laboratory and from the physical examination was so inconstant and uncertain that it is felt to be of value only if positive. The history, when typical, has always been thought to be of the very greatest value, and certainly it seems to us to rank second in importance and in reliability only to the roentgen examination. The present small series, however, would seem to substantiate the view that it, too, has value only if positive, and even then may be misleading. Particularly have we been disappointed in the results from fractional gastric analysis.

This proceeding, which had previously been occasionally used in our laboratory, we adopted as a routine in all ulcer suspects about a year ago. The suppositions upon which it is based seemed so reasonable and the technique so adapted to permit accurate following of the digestive process, that we hoped to obtain, as others believed they had, consistent findings which would offer material aid in diagnosis and in guiding treatment. The finding that many of the acid curves so constructed seemed to adhere closely to previously described types, and were often in accord with the evidence obtained from other sources, supported us in this hope. The fact, however, that only about one-third of this series of cases gave at all typical ulcer curves, while the remainder were either normal or subacid, coupled with the not infrequent finding of high or rising acid curves in conditions which were obviously not ulcer, as for instance chronic appendix, and gall-bladder cases, has left us without much confidence in the evidence to be obtained by this method. Recent work seems to offer an adequate explanation of this unreliability, since it has apparently been proved that the gastric contents are not intimately mixed and homogenous except at the end of gastric digestion. Samples taken at intervals of seconds, through the same tube and from the same stomach have shown variations as wide as thirty points in the free acidity. Furthermore, there is probably no direct connection between gastric acidity and ulcer. It is well known that duodenal ulcer and complete achylia may occur together, and it is probable that when increased acidity does occur it depends rather upon obstruction from pylorospasm or from organic causes than upon any direct influence of the ulcer itself. As pylorospasm is by no means a constant condition in ulcer, neither may hyperacidity be expected to be.

There are rather obvious reasons why blood in the stomach contents or the stool should be an inconsistent and occasional finding. Massive hemorrhage occasioned by the erosion of a vessel is, of course, a positive and dramatic, but fortunately, rather rare symptom. The presence of minute quantities of blood must depend on trauma either from hyperperistalsis or from food, and must necessarily be of rather capricious occurrence. Further, the possibility of error from outside sources, as traumatism from the tube, in the case of gastric contents, and the introduction of blood from the lower gastro-intestinal tract in the case of stool specimens is too great to permit of reliance either in a positive or nega-

tive direction being placed on this finding.

The characteristic feature of the typical ulcer history is pain, occuring two or three hours after eating—in other words, at about the time the hyperactive stomach of the ulcer patient has emptied—and assuaged by food or by alkalies. It has been shown quite conclusively that this pain is not caused, as was formerly supposed, by hyperacidity, but rather by excessive peristalsis. Many clinical and physiological studies have proved that the pain and the peristalsis are synchronous, and that the acidity may be nil at the moment of the greatest pain. Hyperacidity, when present, may reflexly induce contraction and thus indirectly cause pain, but is neither the direct nor the only causative factor. On the other hand, when hyperistalsis is not caused by excess of acid it is undoubtedly due to reflex effects from the ulcer itself, and therefore should be expected to vary with the location of the ulcer as regards the nerve paths and with the extent of the zone of inflammation, and consequently hyperexcitable nerve endings, about it. These two variable and more or less accidental factors probably explain the frequency with which atypical histories are encountered.

On the other hand, there are obvious reasons why the x-ray evidence should be consistent and reliable. It is based upon two pathological changes which must of necessity accompany, in greater or less degree, all active ulcers, namely, the break in continuity of the mucus membrane itself, and the inflammatory zone, with its irritated nerve ending, surrounding it. The direct roentgen evidence, which is to say the cap deformity, depends in variable degree upon these two factors acting together, a part of the deformity, indeed sometimes practically all of it, being reflex in character. The known ability of very small ulcers to produce a massive and persistent deformity depends upon the accompanying inflammatory irritation of adjacent nerve paths. The subsidence of the inflammatory zone as healing progresses explains the lessening cap deformity in the face of the fact that the scar may be as large as the ulcer. When healing has finally occurred ,if the lesion has been deep enough to produce a scar of any size, an irregularity will persist, but it will be unaccompanied by any exaggeration from reflex sources. The failure of the surgeon, by external inspection or palpation of the duodenum, to find many ulcers diagnosed by the roentgenologist upon what was, to him, very conclusive evidence, is, of course, explained by the reflex character of the considerable deformity seen by the roentgenologist, the ulcer itself in these instances being small and shallow without induration of the base or scar formation. Indeed, it may be merely an erosion of the mucosa. General anesthesia will abolish such reflex spasm, while atropin, at least in ordinary dosage, will not do so. The so-called indirect roentgen evidence, including retention, hyperperistalsis, hypertonus, and hypermotility, is, of course, all reflex in character, except where the retention is based upon organic obstruction, but is again sufficiently direct character that it is not abolished by ordinary doses of atropin, as is the case with spasm from extrinsic causes.

In the future we shall probably be satisfied with the laboratory report from the one hour test meal, placing little emphasis upon the acid values, and considerable stress upon the presence of gastric mucus, blood, evidence of retention from the previous meal, etc., with possibly also a routine analysis of the fasting stomach contents. The importance of a careful and searching history, of course, must remain unquestioned, but failure to obtain historical evidence of ulcer will not act to cast doubt upon positive x-ray findings.

EDITORIAL

The JOURNAL OF RADIOLOGY

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Radiology Today and Tomorrow

NO THINKING MAN can read Floyd W. Parsons' article in the Saturday Evening Post of March 10th under the heading, "Science and Everyday Life," without being impressed with the outstanding fact that radiant energy is becoming more and more recognized as the keystone of the arch of all science.

This means that radiology as such embraces a much greater field than the mere application of x-rays diagnostically and therapeutically. There are many other octaves in the spectrum which probably have as great, if not greater possibilities therapeutically. For instance, ultra violet in the past couple of years has come to be recognized as having a much wider range of application in the common everyday run of human ills than perhaps x-rays. And this statement is entirely devoid of any thought of repugnance to the enormous diagnostic and therapeutic value of x-rays.

But without particularizing with reference to the divisions and subdivisions of the science of radiology, medically and biologically, it is worth while noting the fact that there is a rapidly increasing recognition of the wide uses of radiant energy in the commercial field. One or two illustrations will suffice: chemical analysis, the discovery of spurious paintings, the grading of paper, differentiation between cotton, wool and silk in manufactured goods, and the disintegrating of water by radioactivity in the manufacture of ammonia.

Without indulging in quotations, the Journal desires now to call attention again to an editorial found therein in the February, 1922, issue, entitled "A Scientific Renaissance," for that editorial portrayed our belief in the future of the science of radiology—a belief which is becoming more vital to the conduct of this science as an integrated part of everyday life.

As has been previously stated, there are a great number of men in the world who are interested in the medical and biological application of this particular science. To perform a real service for these laborers in the medical profession is the object of the Journal. And since most of these men have no especial knowledge of physics or ultra-scientific characterizations, due to the fact that this science has been discovered and applied since their medical training was finished, it becomes necessary to develop the various phases discussed in language that is easily comprehensible.

By the same token, it will be recognized that if the Journal is to be "of the greatest service to the greatest number," it will have to carry a message for every man interested in the science, whether he holds himself out as a specialist or uses radiant energy in some form merely as an adjunct of his medical practice.

The science of radiology has become so important to the man in the street therapeutically, and perhaps biologically, that entire freedom from the machinations of cliques and partisan politics of the few or many, must be maintained at all hazards. Each issue of the Journal must be so builded that it will constitute a stepping stone to that greater application of the science it represents and espouses, which must be the ideal sought to be achieved by every honest devotee, whether he be a member of the medical profession or not. The man practising medicine in the isolated community who seeks to bring this science into his own practice for the benefit of his patients is in just as great, if not greater need of the assistance this publication can and should bring him, than is the man in the large centers who has access to the experience of other men in his particular field.

Finally, the opportunity for humanitarian service is much too great for any constricted and narrow interpretation of the science of radiology; and if the radiologists of today hope to merit the respect of the radiologists of tomorrow, nothing less than an entirely unselfish and far-visioned purpose can suffice.

Research

ALL SCIENTIFIC advance is made by painstaking research, research carefully planned and diligently executed. We have just celebrated the centenary of the great Pasteur to whom medicine of today owes its very existence. Although Pasteur himself was not a physician, his investigations in bacteriology proved the cause of various bacterial diseases. At the same time, he showed us the cause of putrefaction in various food-stuffs and thus was the father of modern methods of preserving fruit and vegetables, pasteurising milk and using refrigeration. The inspiration thus given has led to the stamping out of smallpox, diphtheria, typhoid fever, malaria and yellow fever.

When one of our leading surgeons first came to Omaha he spent many sleepless nights doing intubations and tracheotomies to save the lives of children dying of diphtheria. At that same time an acquaintance of ours buried seven children in one winter, all had died of diphtheria. He himself was compelled to dig the grave of the last one, so great was the fear of the epidemic. Is it any wonder they called it the "black plague"? Contrast this picture with the low mortality rate nowadays, since the general use of diphtheria antitoxin. And thank God that your children were born today instead of in the days before diphtheria antitoxin was known.

Typhoid fever was formerly one of the most common and one of the most deadly bacterial diseases. So recently as during the Spanish-American War, deaths from typhoid fever were many times more numerous among soldiers than deaths due to war wounds. In the recent World War, scarcely a soldier died of typhoid fever. There is scarcely a family grown to maturity but has one or more vacant chairs in the home, from death that was due to typhoid fever. Well do I remember a brother physician who was cut off at the zenith of his professional career by typhoid fever contracted from the polluted water supply of a city where he had attended a national medical meeting. The

research of Pasteur and his successors has made possible the prevention of such catastrophies as those just enumerated.

The French engineers realized the advantages and possibilities of building a canal through Panama but yellow fever killed the men more rapidly than new ones could be supplied to take their places. It remained for the Americans, Reed, Carroll, Lazear, Agramonte, Cook, and others, to offer themselves a living sacrifice to prove that the cause of yellow fever had been discovered. When this was definitely proved the methods of prevention were already at hand. Due to this fact, not only has the Panama Canal been built, but the country along its borders has in reality been made more healthful than the United States. The death rate in the Panama Canal Zone, according to the United States census of 1910, was 1.7 per cent, while in New York City, Philadelphia and Washington, D. C., the rates were 2 per cent, 2.1 per cent and 2.2 per cent, respectively.

The ability to conquer tropical diseases opens up wonderful possibilities for civilization and may mean that the greatest future development in civilization will be found in the tropics. Mr. Herbert J. Spinden, in the February number of the World's Work, has called attention to this trend of civilization. Would that Pasteur's spirit could hover over us now and see not only what has already been accomplished through his efforts in research but the possibilities for the future.

Turning more particularly to research in the field of radiology, let us look for a moment at the developments which have followed the work of Wilhelm Konrad Roentgen. We imagine that he little dreamed when he first discovered the rays that he had found a scientific truth which would upset the whole arrangement of chemical elements and at the same time would make possible the analysis of unknown chemical substances by so simple a procedure as making an x-ray spectrogram. We doubt whether he realized that he had laid the foundation for the discovery of radium or that he had set in motion work which would make it possible for one to speak around the world by radiophone. Yet in the twenty-seven years that he lived after his wonderful discovery, he saw these very things made possible. The x-ray was adopted almost immediately by the medical profession, but its use is not confined to medical purposes. It is used in the pearl industry, in the tobacco industry, in the chemical industry, in the steel industry, in the shoe industry, in law, in biology and probably in many other ways not mentioned.

To the painstaking effort of Roentgen and his followers, we owe all these advances. We should not pass without mention of the work of Mr. Clyde Snook, W. D. Coolidge, Ph.D.; William Duane, Ph.D., and Friedrich Dessauer, Ph.D. The works of these men stand as their memorial. All of them, save Roentgen, are still living and are still busily engaged in further research. Who can forecast what their future achievements may be? The accomplishments of these men illustrate the epigram said to have come from the lips of Dr. W. J. Mayo, "The first problem in research is to find the man."

The present trend in economic life is toward organization. This trend has also affected the medical profession. There is a desire on the part of the far seeing leaders in medicine to coordinate all effort. This same spirit affects the various branches of medicine and among them radiology. In a recent address, Sir Humphrey Rolleston, President of the Roentgen Society of Great Britain, pleaded for a unification of all radiologists of Great Britain. There are now two societies of radiologists in Great Britain but it may be possible that through the efforts of Sir Humphrey Rolleston, a union will occur which will enable the British radiologists to present a unified effort and will at the same time make possible more rapid advance along many lines.

The aims and purposes of the Radiological Society have been to coordinate all efforts in radiology in North America. This society works in the closest harmony with the Canadian Radiological Society, the American Roentgen Ray Society and the Amercan Radium Society. At the present time, the membership roll of the Radiological Society includes practically all the members of the other societies mentioned. This close relationship should be of great value in promoting research work in America.

The American Roentgen Ray Society has fostered research for a number of years by giving a prize each year to the person who presented the most valuable work on some research problem.

The American Roentgen Ray Society, together with the Radiological Society, has cooperated for several years with the National Research Council, with headquarters in Washington, D. C. Dr. A. W. Crane acts as chairman of the section of roentgenology.

The Radiological Society has been working for some time, attempting to establish an endowment fund for research, the income from this fund to be used in promoting research. A considerable fund has already been accumulated and more is being added. This fund should constantly grow by gifts from individuals and corporations, as well as by annuities and estates left to the Society by will. In due time, a fund of large proportions should accumulate which will make possible investigation along lines needed in radiology and physiotherapy.

Midyear Meeting

THE MIDYEAR MEETING of the Radiological Society will be held in San Francisco, June 22nd and 23rd, the Friday and Saturday preceding the meeting of the American Medical Association.

Those desiring to appear on the program should write to Dr. L. T. LeWald, St. Luke's Hospital, New York City, who is chairman of the program committee, or to Dr. R. D. Carman, President of the Radiological Society. The program is almost complete so immediate action is imperative.

The meeting will be held in Polk Hall of the Civic Auditorium, which has a seating capacity of 1,200. Commercial exhibits will be arranged in wide corridors immediately adjoining the meeting hall, and the scientific exhibits in two reception rooms each about 18 by 30 feet through which one must pass to reach the meeting room.

Dr. W. E. Chamberlain, Stanford University Hospital, San Francisco, is local chairman of the committee on scientific exhibits and would like to have an exhibit of films from as many men as possible. If films can be mailed to him in advance it will greatly facilitate the work of the committee.

The Palace Hotel has been selected as headquarters and 100 rooms have been set aside for use of Society members. The prices of rooms are $8, $9 and $10 a day for two in a room. All rooms have baths. We are informed that those desiring accommodations should write at once since reservations are already at a premium.

Dr. M. P. Burnham is chairman of the local entertainment committee. Preliminary arrangements so far made by this committee are for a dinner and dance at the Palace Hotel the night of June 23rd. For Sunday, the following day, a motor trip is planned to the Santa Cruz big trees where luncheon will be served, thence to the beach at Santa Cruz. This trip comprises a scenic drive of about 100 miles each way. Golfers should note the kindness of Dr. Lloyd Bryan, Butler Building, San Francisco, who will, if notified, make arrangements for any member to play on the local golf courses. Dr. Bryan also announces that visiting cards will be issued to the Olympic Club, one of the attractions of

which is the swimming pool. Besides these entertainments and courtesies the committee has arranged trips to Mt. Tamalpais, to the campus of the University of California and to that of Leland Stanford University.

Wilhelm Konrad Roentgen*

The Discovery.

IT IS LATE in the fall of 1893. The ancient town of Wuerzburg is basking in the autumn sunlight in the vine-clad valley of the Main. In the broad and tree-lined Pleicher-Ring is the Institute of Physics. Within its walls in a room littered with scientific apparatus, a man stands deep in thought before a glass bulb glowing with colored light. He is of middle age, tall, heavily bearded, with a face almost spiritual in its aspect. His brow is broad, the eye, though deeply set, glows with kindness; the lips are thin, the mouth is firm. It is the face of an ascetic and a thinker.

The little glass tube he studies so intently as it glows and flickers with its iridescent hues—what an amount of thought of painstaking, laborious investigation it represents! Pluecker, Gassiot, Geissler, Hittorf, Varley, Crookes, and Lenard and before them all, Faraday—how persistently the human spirit strives to find the meaning of nature's mysteries! How crude the beginning, how halting the progress, how hidden the goal. How slowly the foundations are laid, often without definite plan; the walls rising haphazard, isolated, disconnected, until the master mind sets the cupola and Lo! the structure glows with a beauty and significance undreamed of.

In this vacuum tube, energized by the current of an induction coil, lie many of the mysteries and marvels, not only of modern electricity, but of matter itself—its ultimate constitution—the master problem of the universe. Geissler had passed the induced current through a tube of low vacuum and had produced the exquisite color effects. Hittorf had discovered the cathode ray therein. Crookes noted the change in the phenomena, as the vacuum was increased to about one millionth of an atmosphere. On Hertz's suggestion Lenord brought the cathode stream out of the tube, and studied it exhaustively.

All this was in the mind of Wilhelm Konrad Roentgen, then professor of physics at the University of Wuerzburg, as he watched the flickering bulb. He noted the beautiful green fluorescence of the glass of the tube, just as Pluecker had done thirty-five years ago, and thought of Crookes' designation of "radiant matter" as that influence which apparently radiated from the negative pole.

Absorbed in thought,[1] he did not notice how quickly the hours flew. Called from the room, he laid the still glowing bulb on a book he had been reading that morning, in which lay a large, flat, antique key, which it was his wont to use as a bookmark. It happened that underneath this book lay a photographic plate holder, which he had prepared for an afternoon's outing. Returning later to the laboratory, he gathered up several plate holders, among which was the fateful one under the book, and spent the afternoon outdoors, seeking recreation and amusement in the practice of his hobby, photography. He made several exposures. On developing the plates, a shadow of the antique key, his bookmark, appeared on one of them. He wondered how this could have happened. He showed the plate to his students and asked them for their ideas, but none of the explanations offered satisfied him. How came the image of the key upon the plate? The fogging of photographic plates in the proximity of energized vacuum tubes had been noted before, but to Roentgen's scientific mind this phenomenon demanded a satisfactory explanation and he proceeded to analyze it.

Hertz had said that something passed through the walls of the tube. But these were cathode radiations from the Lenard tube, which Lenard had so thoroughly studied. It was known that these cathode rays, when brought through the aluminum window of a vacuum tube, moved in straight lines, discharged electrified bodies, penetrated thin substances, and affected photographic plates. But this was no Lenard tube with an aluminum window, but a relatively highly exhausted Crookes' tube, and neither cathode rays nor ultraviolet light could pass through the glass of the tube and accomplish this. Roentgen decided therefore to search for the mysterious agent which had so silently recorded its presence. He restaged the drama, placing the glowing bulb, the tube, the book, the key, and plate exactly as before, and energized the tube for the same time as on the preceding day. He developed the plate and Lo! the shadow picture of the key was on the plate. Invisible light? Was some influence emanating from the glowing bulb that had the power of penetrating solid objects and affecting the photographic plate?

Let him who will, speak in admiration of the poetic imagination which soars on spiritual wings in the world of fantasy, singing words that soothe the ear and weaving fancies that stir the emotions. The imagination of the scientist far transcends that of the poet, not only in the scope of its fancy, but surely in concrete accomplishment. The imagination of La Place reached out into the infinite heavens and made possible the measurement of the courses of the eternal stars, the weighing of them as in a balance, their analysis as in a test tube. In the microcosm, the inspired imagination of a Pasteur caused the isolation of a host of organisms, whose destructive and constructive functions are so greatly the concern of medicine.

The imagination of Harvey lifted his eyes from the rutted paths over which legions of physicians since the time

of Galen had traveled, to a newer vista where lay the truth of the physiological problem of the circulation of the blood. So, too, the scientific imagination of Roentgen dared to dream of what was almost scientific heresy, invisible light.

Noting the green fluorescence of the glass of the Crookes tube, he conceived that other substances might be similarly affected. He, therefore, surrounded the tube with a light proof envelope, and sure enough, a platinobarium cyanide screen, even at a distance of nine feet, fluoresced brilliantly green in the darkened room. Eureka! He had it—a ray invisible to the eye which traversed solid substance. He placed his hand on a covered photographic plate, energized the Crookes tube above it, and obtained a photograph of the shadows of the bones.

He at once saw before him the problem in all its possibilities. To study the invisible energy, to determine its nature, its origin, its characteristics, this was the work to be done. He carried on his researches in all phases of the problem, and when convinced at last that he had discovered a new form of radiation, reported his results briefly on two occasions before the Wuerzburg Physicomedical Society, December 28, 1895, and March 9, 1896, in a paper entitled *A New Form of Radiation*. In 1897, before the Royal Prussian Academy of Science, in Berlin, he made a third communication, *On Further Observations of the Characteristics of the X-rays*.

Let the captious critic point out that the placing of the glowing bulb upon a book containing a metal key and under which lay a plate holder, was a fortuitous combination of circumstances, a master stroke of the blind madonna of pagan Chance, but who will doubt, knowing the thoroughness of his methods, that sooner or later Roentgen would have made this discovery as a logical step in his researches?

His Life

Roentgen was born in Lennep, in Eastern Prussia, March 27, 1845.[2] It was planned that he should follow the agricultural occupation of his father, and his scientific education was therefore begun at the engineering school at Apeldoorn in Holland. He entered the Polytechnic School at Zuerich several years later. Clausius was at this time teaching physics in this university, and it cannot be doubted that the young student listened with rapt attention to this great teacher, who developed the principles of the dissipation of energy and first advanced the mechanical theory of heat production.

Roentgen graduated from the university with the degree of Doctor of Philosophy. As a student he manifested an extraordinary aptitude for work requiring exactness in detail, and his industry and ability won him immediately after graduation an assistantship to Kundt, whose favorite pupil he was and with whom he was associated for many years. Roentgen ever held him in highest veneration as his teacher and guide. To him he owed the exactness of his methods, his accuracy of thought, and his thoroughness in investigation. When Kundt was called to Wuerzburg in 1870, Roentgen went with him and, in 1872, followed him to Strassburg, where he became a private lecturer in physics. In 1875, at the age of thirty years, Roentgen was appointed professor of mathematics and physics in the agricultural academy at Hohenheim, but left the following year, at Kundt's request, to return to Strassburg, where he assumed the position of the associate professor, teaching theoretical physics.

In 1879, however, at the age of thirty-four years, he was called to Giessen as full professor and director of the institute of physics. Here he remained for nine years, until appointed director of the physical institute in the great school of Wuerzburg, the second most important university of Bavaria.

It was here that the discovery of the x-ray was made. In 1900, after twelve happy, active and useful years of service, and at the special insistence of the government, he accepted the position of director of the Royal Academy of Technical Physics of the University of Munich, which position he occupied until his death. The presidency of the Royal Physical Institute of Berlin was offered to him, but declined. Honors and titles from all corners of the civilized world have been bestowed upon Roentgen. Immediately upon announcement of the discovery, the Emperor invited him to demonstrate the x-rays at the Palace of Potsdam, where he was awarded the Crown Order of the Second Class. The title of *Excellence* was given him by the German Government and his statue was erected on the Potsdam bridge in Berlin. In 1901, he obtained the Nobel prize for physics, the first of the awards made. The rays he discovered have, by general consent, been named after him. The honors and acclamations of the world never in any way affected the modest, generous, and lovable character of the man. Nor can it be said of him that he ever derived any material gain from his important discovery. He gave it to mankind freely and wholly.

His Work.

Before 1895, his scientific work related to various questions in experimental physics; the examination of the specific heat of gases, the study of isothermal crystals, solar calorimetry, dust figures, aneroid barometry, and the absorption of heat by vapor. Since then his efforts have been mostly devoted to electricity and the phenomena of exhaustive tubes.

In the consideration of Roentgen's scientific labors, one characteristic that stands out above all others is the self restraint shown in his intellectual activities and his reverence for temperate and accurate deductions. His was the mind of a mathematician and his schooling was one in thoroughness, exactness and precision. Indeed, as a keen, inductive thinker he has had no peer in the modern scientific world. Nowhere in any of his productions is there a hasty conclusion based on insufficient premises, nowhere any unfounded generalization. It is always the careful, painstaking work of an investigator, who constantly denied himself the joys of enthusiasm, persistently repressed his emotionalism and the tendency to glorification in his achievement. The constant self questioning, the constant searching analysis of his own beliefs and observations, indicates a mental asceticism which characterizes the highest type of scientific worker. He permits the facts to speak for him. His experiments, therefore, have an elemental firmness, strength, and finality. It is the quality and not the quantity that renders his work of such surpassing value.

We are too near the age to obtain the proper perspective of the personalities which will dignify it, but from the distance of centuries, Wilhelm Konrad Roentgen will be seen as one of the towering figures of our time.

I. Seth Hirsch, M. D., New York City.

Footnotes.

*—A Biographical Sketch. Copyright, 1915, by A. R. Elliott Publishing Company.

1. This episode is based on an account given in *Popular Science Monthly*, December, 1908, by E. E. Burns, who attributes it to Dr. T. S. Middleton, of Chicago, who was a student in Roentgen's laboratory at the time of the discovery.

2. For many of the facts in this biographical sketch I am indebted to A. Sommerfield's article in *Physikalische Zeitschrift*, 1915.

Honor to Whom Honor is Due

DR. CHARLES VAILLANT, French roentgenologist, who for the past twenty years has labored at La Ri-

boisere Hospital in Paris, is another of those scientists whose early researches have demanded a visible toll of the flesh.

Dr. Vaillant, from exposure to x-rays in the early days suffered the loss of the little finger of his right hand in the year 1919. Since that time he has endured twelve operations until now the right arm is amputated at the shoulder and the left one just below the elbow. Undaunted he still directs the work of his laboratory in La Riboisiere Hospital, and recently France and America combined to show their appreciation of his work in the field of roentgenology.

France, through the person of General Dubail, Grand Chancellor of the Legion of Honor, bestowed upon the scientist the Cravate of the Legion of Honor, one of France's choicest rewards to her heroes. Paris upon the same occasion decorated him with the Gold Medal of the City of Paris, and America, speaking through Myron T. Herrick, our American Ambassador to France, presented him with the Carnegie Hero Medal.

Dr. Vaillant received his honors with modesty and dignity of manner and with a radiancy of spirit shining in his face that has caused witnesses of it to marvel at one who though he has sacrificed so much in his life's work can yet think more upon the joy of his achievement than upon its great cost.

We rejoice that the world increasingly honors its great men of peace. Some day when the futile bickerings of all the nations have ceased there will be time and quiet to look around a little, to do more thinking than is now possible, to better understand, and as a result to reach out helping hands and to speak words of appreciation to all those who, because of the spirit that is in them, are bending their life's efforts toward a happier destiny for the race.

Regarding the Chiropractor

THE movement to exclude from the Journal the advertisements of manufacturers who sell x-ray equipment to chiropractors, is one of those acts of futility which tend to make our profession appear ridiculous in the eyes of the commercial world.

Whatever action we may choose to take, we cannot, even if we desire to do so, prevent the chiropractors or any other group from obtaining in the open market any equipment needed in the practice of their profession. Surely no cult now attempting to diagnose and treat disease has more plainly shown the need of revelations such as the x-rays alone can offer than has the chiropractor. In any event he will not be a greater menace to a long suffering public with this diagnostic aid than without it. As long as our laws permit these perennial cults to treat sick people we cannot, nor should we try to, prevent the sale to them of physical equipment.

How much wiser would it be for the Journal to accept all advertisements of honest goods and use any surplus revenue earned thereby in propaganda aimed toward more strict educational requirements for those who would diagnose and treat human disease.

F. S. BISSELL, M. D., Minneapolis.

NEW EQUIPMENT

A New Deep Therapy Diagnostic Machine Announced

THE January-February number of "Service Suggestions," issued by the Victor X-Ray Corporation, contains further particulars on the "Snook-Special," the new Victor intermediate model combination deep therapy and diagnostic machine. There are a number of features set forth in the descriptive matter that are interesting to note, for they seem to be definite advances in the manufacture of this type of apparatus.

The designers in this instance have again utilized the Snook principles of rectification and claim to have even increased the efficiency and reliability of the original Snook rectifier. This in itself would represent an immediate benefit to the roentgen art.

It seems that first consideration in designing this machine was given to the electro-static field which is set up in high voltage machines, a factor which, as is well known, gives rise to voltage surges and consequent inconsistent operation of the tube, with the tendency to cause damage to the latter. Victor engineers point out the advantages realized in the "Snook-Special," through establishing electrostatic balance throughout the machine. Instead of unequal stresses between machine parts, they have so designed it that these stresses are equalized, as it were, so that no spark over occurs at any point until the voltage impressed exceeds the maximum capacity of the machine. The end result of this is the elimination of corona between adjacent parts. The theory that such design makes for better tube operation and utmost protection to both machine and tube seems obvious enough.

The voltage capacity of the machine for deep therapy is given as ranging from 50,000 to 200,000; and in milliamperage it has a running capacity of 50 milliamperes which is considerably in excess of the milliamperage capacity of the present Coolidge deep therapy tube.

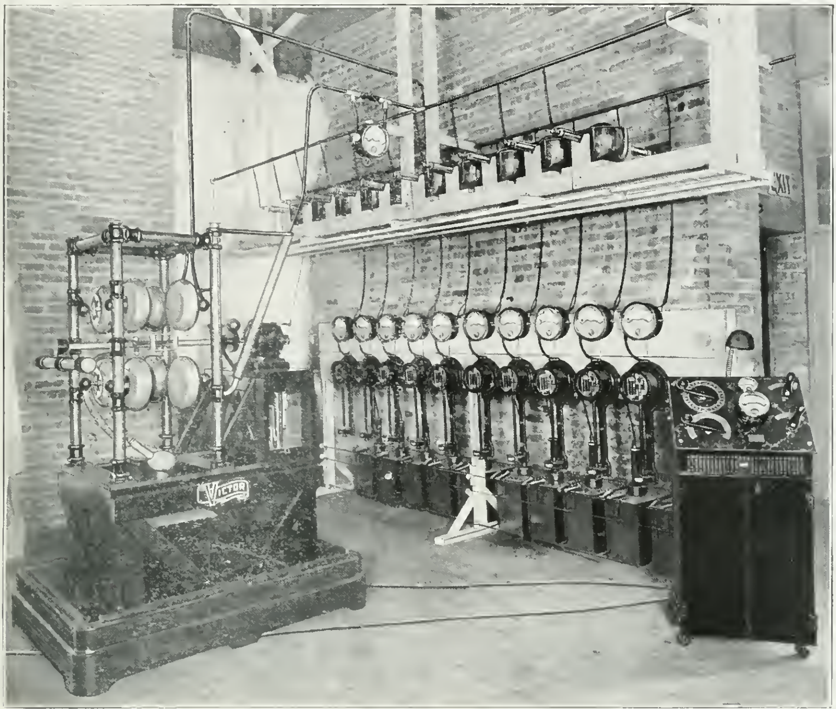
To substantiate all that has been clamed for this machine, the accompanying illustration has been submitted, showing a view in the Victor experimental department, of an "Intermediate" installation by means of which ten Coolidge deep therapy tubes are energized simultaneously, at 200,000 volts with 3 millamperes through each tube. A separate Coolidge transformer and stabilizer set is provided for each tube, as can be seen in the picture. The statement is made that this is the first time, so far as known, where ten tubes are energized by one transformer, at this voltage and milliamperage, and with the machine running constantly.

This installation is also made to demonstrate the value of the Victor-Kearsley stabilizer, for here it is possible to adjust one or more of the sta-

bilizers, independently, to increase or decrease the milliamperage in any of the ten tubes selected, without affecting the milliamperage through the remaining tubes. It is pointed out that this is possible only when the Victor-Kearsley stabilizer is interposed.

Previous announcements of these manufacturers have laid much stress on the importance of the Victor-Kearsley stabilizer in radiography. When we are told that it functions with the same accuracy in connection with deep therapy apparatus, where even the slightest fluctuation in milliamperage is of vital concern, considering the long periods of treatment, then the importance of this accessory to the roentgenologist is increased many times.

The "Intermediate" can be used also as a diagnostic machine, its capacity, according to the designers, providing for all branches of radiography.



CASE REPORTS

Observations of the Development of the Normal Knee

A Preliminary Report

L. R. SANTE, M. D.
St. Louis

ON SEVERAL occasions examination of the knee joint between the ages of about 4 and 8 years revealed a roughening of the articular surfaces of the joint. These examinations at first were made in connection with definite pathological conditions, and on several occasions a mistake in diagnosis was only avoided by a comparison with the normal knee. The writer has seen this condition mistaken repeatedly for an arthritis, and is convinced that it is not generally known that this is a normal stage in the development of the knee jont. Repeated examination of normal individuals between the ages of 4 and 8 years, reveals the condition without exception. Before 3 years of age no evidence is present of the condition and after 10 years the joint surface has again become smooth. The condition seems to begin at the first indication of patellar ossification, and to last until its full development is completed.

One of the conditions in which this was first observed was in a boy who

Fig. 1-a—Polyarthritis with swelling in several of the joints. The irregularity of the joint surfaces was mistaken for a bony destruction, owing to the co-existing effusion. Antero-posterior view.

Fig. 1-b—Examination of the normal knee, however, reveals as much if not more roughening than that encountered in the swollen knee. This is a plate of the normal knee taken for comparison.

had symptoms of arthritis. X-ray examination showed this condition and a roughened, uneven appearance of the lower end of the patella. The condition was diagnosed as pyogenic arthritis, but examination of the other knee revealed the same condition with the exception that the patella appeared smooth. This irregular appearance of the patella at the tendinous attachment of the patella has been observed in three such cases, it probably was the etiological factor in the "arthritis" in these instances. The irregular joint margins are undoubtedly normal. In a case of polyarthritis (?) the condition formed in one knee joint was thought to be due to arthritis, but examination of the other knee revealed that it was normal (Fig. 1).

In still another instance, by reason of this roughened appearance, a beginning osteomyelitis was almost mistaken for an arthritis. The other knee showed a similar appearance (Fig. 2).

In a recent article by Cohn on the normal development of the knee joint, this condition is shown in the accompanying radiographs, but no mention is made of its significance or appearance or of its pronounced character in some instances.

This condition has not been observed in any of the other joints of the body. Investigation is now being carried on to see if the condition exists in animals and if possible to determine its cause.

Fig. 2-a—Lateral view of knee with arthritis and effusion showing less roughening of joint surfaces than the normal knee in the same patient.

Fig. 3-b—Lateral view of normal knee in same patient as Fig. 2-a. Note that the joint surfaces show more roughening than in the affected knee, Fig. 2-a.

Fig. 3-a—With the finding of an irregularity of the joint surfaces of the knee joint and pain in the lower end of the femur an early osteomyelitis was almost mistaken for an acute arthritis until the opposite normal knee was taken for comparison. Note the periosteal reaction.
Fig. 3-b—Note that the joint surface shows the same roughening as that seen on the affected joint. This is undoubtedly normal.

ABSTRACTS and REVIEWS

Progress and Results in Cancer Control. Frederick L. Hoffman, LL.D., Consulting Statistician Prudential Insurance Co., Boston M. & S. J. 188:221, February 22, 1923.

THE writer believes that the increase in the cancer death rate is a real one but also he believes that cancer control is being more and more realized. It is only the increased effort to combat cancer that keeps the rate as well under control as it is. He says, "Those who are of the opinion that the increase in cancer is more apparent than real, base their conclusions upon guess work, not entitled to serious consideration. The increase in cancer is a world phenomenon." The death rate for 1921 is estimated at 100 per 100,000 in this country and reaches the maximum in San Francisco, California, and in Portland, Maine.

Cooperation between "an aroused medical profession and an aroused public interest" must greatly increase before any marked control of the death rate can be attained. A step in this direction which the author believes may have far reaching consequences is the action taken by the John Hancock Mutual Life Insurance Company which has arranged with the Cancer Commission of Harvard University to give its policy holders free examination for suspected cases of cancer. The examinations are made at the Huntington Memorial Hospital which is fully equipped with the latest and best apparatus. Examinations are made by the regular physicians of that hospital and advice is given free of charge, though, of course, treatment is at the patient's expense.

The Intensive Radiotherapy of Cancer: Is It a New Method? A. Joseph Riviere, M.D., Paris. Medical Review, Paris, March 15, 1922 (Reprint).

IN 1903 A. Darier reported to the Academie de Medecine, Paris, the then startling results secured by the use of deep therapy in a case of generalized lymphosarcoma. Darier had made the histological examination and stated that there was no doubt of the diagnosis. The treatment was applied by Dr. Riviere and consisted of "a daily application of roentgen rays for ten minutes, followed immediately by a local application of ample bi-polar effluvia of high frequency. The rays employed were half-soft, produced by a large bi-anodic Muret tube, influenced by a spark coil of 40 centimeters, whose condensing capacity was 0 microfarad 66. The interruptions (to the number of 1,200 per minute) were supplied by a mercury interrupter worked by a motor. The primary current of the coil measured 60 volts, with an intensity of 6 amperes at the moment of interruption. The quality of the rays corresponded to No. 7 of Benoist's radiochromometre. The anticathode was placed at a distance of 20 to 25 centimeters from the teguments." A radiodermatitis resulted at the fifteenth sitting because the patient, unknown to the doctor, approached too near the tube. This radiodermatitis, however, he believed was rather beneficial than otherwise. Dr. Riviere in his report of this case in 1903 stated that it was necessary, to secure curative results in x-ray treatment, "to employ massive doses of x-rays of different qualities, according to the nature and depth of the anatomical tissue to be traversed."

Not only in 1903 in his communication to the Academy of Medicine, but again in 1907 in his communication to the French Congress of Medicine Dr. Riviere made the following assertions: "(1) That high frequency effluvia and sparks cure malignant tumors, both superficial and deep. (2) That they destroy the neoplastic masses and leave alone healthy tissues. (3) That their action on lymphoid tumors is most marked. (4) That they should, along with x-rays, when applied after operations, serve to prevent recurrence of the malignant tumors. (5) That physicotherapy is the only resource in cases of inoperable tumors. (6) That doses of roentgen rays must be massive without damaging the teguments. (7) That radiodermatitis seems sometimes to promote and favor cure. (8) That it is indispensable to drive the necrosed parts to elimination on account of their return to the general circulation. (9) That the neoplastic cell did not derive benefit from the synergic forces of healthy tissues controlled by the nervous system. (10) That it is always necessary to give attention to the general conditions of the organism as well as to the local condition. (11) That in the presence of an evil so tenacious and so disturbing as cancer, we must know how to proportion effort to resistance, and bring judiciously into play all the resources of the physicotherapic arsenal."

On the Gamma-Ray Action of Extensive Flat Radium Preparations at Different Distances with and without Absorbing Materials. Victor F. Hess, M.D., Physical Review 19:73-79, February, 1922.

IN THIS paper Dr. Hess deduces the mathematical expression for the intensity of gamma radiation at points lying upon the perpendicular line passing through the center of a circular plaque. He also tabulates the values so computed for various distances, varying from 0.3 to 10 cm., from plaques of diameters of 0.4, 1, 2, 4, and 8 cm.; the radiation is supposed to be filtered through 2 mm. of brass. He also gives the corresponding values for an uncovered plaque 4 cm. in diameter, and the values in tissue for the same plaque when covered with 2 mm. of brass and placed directly upon the tissue. As stated, it is solely the gamma rays that are considered; the soft rays arising from the filter are supposed to be absorbed by the interpostion of a suitable layer of a substance of a low atomic weight. The hard primary beta rays are not considered. The coefficient of absorption of the gamma rays in tissue is taken as 0.094 $cm.^{-1}$ which corresponds to a half-value thickness of 7.4 cm. The intensities are expressed in terms of the intensity in air at a distance of 1 cm. from a point source containing 1 mg. of radium. This is often denoted by writing after the number denoting the intensity the notation "mg/cm^2" (read "milligrams per centimeter-squared") denoting that it is arrived at by dividing the number of milligrams by the square of the distance expressed in centimeters. The author proposes that this intensity be called a "milli-eve." The effect of the scattering of the radiation by the tissues is not considered. Attention is called to the fact that though the intensity near the disk varies greatly with the size of the disk, the amount of radium being the same for all, the intensity in air at 3 cm. from the disk is nearly the same for all the disks considered. A more useful fact to remember, however, is that beyond a distance equal to the diameter of the disk the intensity in air is essentially the same (within 5 per cent or less) as if the radium were concentrated in a point at the center of the

disk; at points lying near the disk the intensity is much less than it would be if the radium were so concentrated.

DR. N. E. DORSEY.

Investigations of the Secular Variations of High Tension Direct Currents, Both Intermittent and Pulsating. Friedrich Voltz, Arch. f. Elektrotechnik, 9:247-278, 1920.

THE author investigates the time variation in the current through x-ray tubes of various types when excited by the "symmetrie" apparatus, and also considers briefly the case of a tube excited by one of the usual types of interrupterless machines.

When a Lilienfeld tube is excited by a symmetrie apparatus, each discharge through the tube consists of a series of partial discharges. These result from electrical oscillations set up in the exciting apparatus; they become less pronounced, and the total duration of the discharge is reduced, by increasing the capacity of the condenser which bridges across the interrupter; increasing the voltage on the tube somewhat enhances the effect of increasing the capacity of the condenser.

When a Coolidge tube is excited by a symmetrie apparatus, each discharge is likewise broken up into a series of partial discharges if the capacity of the condenser is small. But the partial discharges are not distinct, as with the Lilienfeld tube, but are crowded together. As the capacity of the condenser is increased, the discharge soon becomes almost constant, the current jumping nearly instantly to its maximum value and staying there until very near the end of the discharge, when it abruptly drops to a very low value. The total discharge is in every case spread over a much shorter time than in the corresponding case with the Lilienfeld tube.

When a self-hardening, boiling, gas tube with an automatic regenerator is excited by a symmetrie apparatus, each discharge consists of a series of partial discharges that are not distinct, but appear as a fluctuating secondary discharge superimposed upon the main discharge. These secondary discharges become less distinct as the capacity of the condenser is increased. The main discharge rises and falls more gradually than in the case of the other two tubes, and is spread over a longer interval.

When an x-ray tube (type not stated) is excited by an interrupterless machine with mechanical rectification of the secondary current, partial discharges are generally present. These are attributed to the sparkinng that occurs at the rectifying switch, and it is stated that they can be very completely eliminated; but how it can be done is not stated.

The observations recorded are not sufficiently numerous nor varied to enable one to decide how far the recorded differences between the effects observed with different tubes are really characteristic of the tubes themselves.

DR. N. E. DORSEY.

Continuous X-Ray Spectrum. H. Behnken. Zeitschr. f. Physik. 4: 241-253, 1921; Applied Voltage and the Quality of the Radiation Emitted by a Coolidge Tube. H. Behnken. Zeitschr. f. techn. Physik. 2:153-160, 1921.

THESE papers are contributions from the Physikalische Technische Reichsanstalt, the German institution that corresponds closely with our National Bureau of Standards. They are reports of different aspects of the same work, and consist of mathematical discussions of observations that have been made by others upon the continuous x-ray spectrum emitted by a Coolidge tube at voltages below 70 kv. Though the data apply directly only to voltages lying below those used in practice, and so give only incomplete information upon the questions of direct interest to radiologists, they do not in this respect differ in any essential from many similar data that are given in papers appearing in radiological journals, and they do serve to bring out certain conclusions that are at least qualitatively applicable to higher voltages.

The radiologist will probably be most interested in the second of these papers and especially in the figures accompanying the latter. In one figure the author gives a series of curves showing the amount of energy of each wave length absorbed by a fixed volume of a thin surface layer. The radiation is unfiltered and is emitted by a Coolidge tube. Curves corresponding to various constant voltages are given; the number of milliampere-minutes being the same in all cases. It is interesting to note that the portion of the spectrum from which the greatest absorption occurs changes very little with the voltage, provided the latter exceeds 50 kv.; this region of maximum absorption is very close to wave length 0.64 Angstroms. This means that for surface effects depending upon merely the relative amounts of energy absorbed from various wave lengths, the quality of the radiation does not change greatly above 50 kv.

Another similar figure applies to filtered radiations emitted at a single constant voltage. These curves show that filtering shifts the region of maximum absorption sharply towards the shorter wave lengths. The effect of a 5 mm. filter of aluminum shifts this maximum from wave length 0.64, corresponding to no filtering, to 0.38, thus changing the quality of the absorbed radiation very materially. In so far as absorption by the surface layer is concerned, increasing the voltage has a hardening effect that is insignificant as compared with that produced by filtration.

In another figure curves are given comparing the distribution of energy in the spectrum of the radiation emitted by a Coolidge tube run on a sinusoidal voltage with that emitted by one run on a constant voltage equal to the peak value of the former; two milliampere-minutes are the same in both cases. As is well known the most intense radiation occurs in essentially the same part of the spectrum in both cases. Two striking facts that are seldom discussed in radiological journals are exhibited by these curves and the table accompanying them. First, for the same number of milliampere-minutes, the amount of x-ray energy emitted by the tube run on the sinusoidal voltage is only about half as great as that emitted by the one run on the constant voltage. Second, if the current through the tube run on the sinusoidal voltage is increased until the energy emission in the most intense portion of its spectrum is equal to that in the most intense portion of the constant voltage spectrum, then the amount of energy emitted at a wave length that is essentially shorter than that corresponding to the most intense portion of the spectrum will be perceptibly less; also that emitted at a wave length that is essentially longer than that corresponding to the most intense portion of the spectrum will be perceptibly greater than that emitted at the same respective wave lengths with constant voltage. The further the departure from the maximum, the greater does the ratio of the energies in the two spectra depart from unity. Hence, if concerned with an effect that depends not upon merely the relative amounts of energy in the various portions of the spectrum but upon the actual amount of energy contained within a limited portion of it, then, if this portion is essentially different from that in which the bulk of the energy is distributed, the sinusoidal spectrum is for this effect appreciably safer than that emitted by a constant current. If the effects considered are of the other kind, the two radiations are of essentially the same quality. These two different aspects of the same change have exact optical counterparts that are well known to all. The most intense portion of sunlight lies near the yellow. Even though quite a percentage of the violet were removed from the sunlight and were replaced by a

corresponding amount of deep red, but a slight change would be visible, but a very great change would have been produced in its photographic effect. In relation to vision, the quality of the light would have remained essentially unchanged; but in relation to its photographic effect, its quality would have been profoundly changed.

In this connection it is interesting to consider the radiations that result when the voltage varies in other ways. It is evident that the resultant radiation is merely the sum of the radiations that are emitted during each successive very small interval of time. The resultant mixture is not solely a question of the voltage changing from one value to another, but is primarily a question of the number of milliampere-minutes expended at each little step in the transition. As the author points out, if the voltage jumps abruptly back and forth from zero to a certain high value, the resultant radiation is the same as if the voltage had remained continuously at the high value; all of the milliampere-minutes are spent at that voltage. The same applies to a tube operated upon an interrupterless transformer with a mechanical rectifier. If the milliampere-minutes expended during the jump from zero voltage to a voltage near the peak of the curve is negligible, then the resultant radiation will be of the same quality as if the tube had remained continuously at these high voltages. If, however, oscillations, as described by Voltz (see preceding review) are set up, the radiation has a quality that corresponds to a sinusoidal voltage, or may be even softer than that. It must be remembered that the difference in softness of which we are now speaking is entirely negligible unless one is concerned with the actual amount of radiation that is carried by a portion of the spectrum that lies appreciably outside the region within which the bulk of the energy is found.

DR. N. E. DORSEY.

A Separate Centre of Ossification for the Tip of the Internal Malleolus. H. A. T. Fairbanks, M. S., F.R.C.S., Arch. Radiol. & Electroth. 27:238, January, 1923.

THREE cases of a separate center of ossification for the tip of the internal malleolus on both sides is here reported. All cases were found in girls of about ten years of age. A diagnosis of sesamoids is agreed to be out of the question by all who have looked at the plates.

A Hitherto Undescribed Bone in the Tarsus. Percival D. Cameron, M.D., Dunedin Hospital, N. Z., Arch. Radiol. & Electroth. 27: 234, January, 1923.

A BONE forming a distinct projection on the inner side of the foot, lying in the angle between the scaphoid and internal cuneiform bones was found by this author in a 24-year-old patient. There was also a "quite definite tibiale externum lying in close contact with the head of the astragalus, between the scaphoid and the sustentaculum tali. Neither of the extra bones was present in the foot of the other side."

Professor Gowland of Otago University suggests that this bone may be the apophysial element of Manners Smith (see J. Anat. & Physiol. 41: 255), or possibly the paracuneiforme of Dwight (see Dwight: *A Clinical Atlas: Variations in the Bones of the Hand and Foot*, 1907, J. B. Lippincott, Philadelphia and London).

Fracture of the Ulnar Styloid Process. Hans R. Shinz, M.D., Deutsch. Zeitschr. f. Chir. 175:81-133, November, 1922.

THE following is the author's summary of this rather lengthy paper:

1. Normally the ulnar styloid process ossifies as a part of the distal ulnar epiphysis.

2. In some disturbances of ossification in connection with endocrine anomalies there may appear an independent center of ossification for this process.

3. Pfitzner's anatomical finding of an os triangulare may be considered a broken off process which has healed and formed a pseudoarthrosis.

4. Even Thilenius' embryological evidence for the presence of an anlage of cartilage which may later ossify independently as an atavistic supernumerary os triangulare is not puncture proof.

5. Fractures of the styloid process frequently occur in cases of sprain of the wrist; these either heal and form a pseudoarthrosis or become absorbed.

6. Every classical fracture of the lower end of the radius with the classical displacement is necessarily accompanied with a fracture of the ulnar styloid process.

7. In the supracondylar fractures of the radius, about an inch above the articular surface of the wrist, there is almost always found a fracture of the ulnar styloid process. In subperiosteal or in green stick fractures, the ulnar styloid process is broken off if already ossified, but if not, a fracture of the epiphysis or chipping of the same may occur.

8. Epiphyseal separation of the radius with dislocation is accompanied with epiphyseal separation of the ulna as well, and may or may not be accompanied with fracture of the styloid process.

9. Luxation of the distal end of the ulna is accompanied by a fracture of the styloid process. Where luxation has become habitual there is often found a traumatic os triangulare.

10. Semilunar dislocation is accompanied by the ulnar styloid fracture. It does not occur with fractures of the os naviculare. True semilunar fractures are usually accompanied by the fractured styloid.

A. M. PFEFFER, M. D.

Congenital Radio-Ulnar Synostosis. E. Sonntag, M.D. Bruns Beitr. z. klin. Chir. 120:716-720, 1922.

THE patient was a boy of 17, who could not very well perform his duties as a baker because of limited supination on both sides. Roentgenographic examination revealed synostosis of the radius and ulna on both sides.

The author had two cases, both boys, each of whom had a double synostosis, and in each case the changes on both sides were not quite equal, the one of the right side being functionally and structurally better, otherwise the elbows and the forearm bones were well formed. Flexion and extension was almost normal and while the musculature was somewhat weak, there were no appreciable defects. Neither case presented any other malformation. Both patients, by using the shoulder joints, were able to perform their duties, and refused operative interference. Neither of them was able to carry anything on the palms of the hands as the position of the hand was always in the pivotal axis. During eating, the spoon could not be held in the usual position but had to be grasped at the tip with the thumb below and the fingers above and brought to the mouth not by leverage but by mere lifting.

The author summarizes this abnormality as beng congenital, hereditary perhaps (one boy had an aunt similarly afflicted), of rare occurrence, with definite symptoms, easily diagnosed by the roentgen rays. Operative interference is the only therapeutic measure.

A. M. PFEFFER, M. D.

Development and Termination of Osteochrondritis Deformans of the Hip (Legg's, Calve's, Perthes' Disease). Drs. Perthes *and* Welsch. Bruns' Beitr. z. klin. Chir. 120: 477-225, 1922.

THE authors observed both clinically and roentgenologically the complete progress of 14 cases of osteochrondritis deformans coxae juvenilis from the beginning until the final arrest. Healing of the bone processes with excellent restoration of the joint function finally

resulted. The duration of the transition from the florid stage until the final arrest was found to be an average of four and one-half years.

Healing results in two typical forms of the head of the femur, the globular form, and the mushroom form. The contrast between the deformity and excellent restoration of function is particularly noteworthy. The best function is obtained in the globular form, while there is some moderately pronounced limitation of motion in the mushroom form.

The roentgen findings of the florid stage showed the epiphysis of the head of the femur markedly reduced in height, and the contour flattened. Within the normal bone shadow circumscribed radiolucent areas were observed, and in some cases the whole epiphysis appeared as if split into several fragments. Through histological examination these radiolucent areas penetrating the epiphysis have been found to consist of projections of cartilage which often connect the articular with the epiphyseal cartilages. With the flattening of the epiphysis there is naturally produced a widening of the same so that it projects farther out than the neck of the femur, it may be entirely displaced laterally. The lateral portion gives way to the pressure influence earlier than the medial portion.

The epiphyseal line remains unchanged even after there is definite destruction of the head, although the persistence of this line does not prevent the disease process from extending into the neck, which gradually enlarges. The portions adjacent to the epiphyseal line contain radiolucent areas, due to cartilaginous deposits. As a result, the neck becomes weakened and giving way to static pressure becomes wider and shorter. At first the line appears serpiginous, but in time becomes entirely lost in the chaos of newly formed deposits and bone changes.

Five cases showed the globular form of end result where the destructive process had not extended across the epiphyseal line. The head became homogenous in appearance, the translucent lesions were no longer present. The head was rounded and the joint space was regular. Abduction and rotation were free, and there was no shortening of the limb and no limp resulted even after much walking. Of course, the projection of the normal hip upon the healed one shows some changes.

Nine cases belonged to the mushroom form of end result. The unchanged head in this form appears like a cylinder or mushroom. The reduction of the height of the head as well as the widening and enlargement of the epiphyseal line and the neck were marked. The cartilage islands disappeared and the shadow was homogenous. Movement was limited by those changes, as well as by a thickening and enlarging of the trochanter. Flexion and extension were normal. There was some shortening of the limbs. Subjective symptoms were not complained of.

The authors find this disease entirely different from arthritis deformans juvenilis, which is supposed to be analogous to the arthritis deformans of older patients. Nor do they accept Fromme's idea who believes this disease to be a form of late rickets.

Etiologically the authors do not accept the idea of trauma being the causative factor as proposed by Legg and Schwartz, but they are inclined to agree with Brandes and Zoijer who consider it a developmental defect analogous to the Schlatter-Osgood form or to Koehler's disease, like the osteochondritic conditions of the head of the second metatarsus, or of the elbow. They emphasize that the pathology consists of a proliferation of cartilaginous deposits at the expense of the bone substance.

As to treatment, the authors found no definite influence resulting from any treatment. Operative measures are not indicated, as the prognosis is good.

A. M. PFEFFER, M. D.

Leontiasis Ossea. Drs. Lesne *and* Duhem. Rev. Neurol. 29:1176-1179, September, 1922.

THE authors report a case of a patient 51 years of age whose complaint was of a gradual enlargement of the head, unaccompanied by deformity or subjective symptoms. The mother, but no others in the family, presented a similar condition.

Since childhood there had been noted an abnormal prominence of the upper maxilla. The patient had been normal in every way, and possessed more than the average intelligence having devoted twelve to fourteen hours daily to mathematical studies.

The head measured 66 cm. in circumference, 23 cm. in the antero-posterior diameter and 17½ cm. transversely. The maxillae were markedly prominent, so that the nose was almost completely effaced. Yet the cranium was symmetrical and uniform.

The roentgenograms revealed a generalized diffused hyperostosis; there was no obliteration of the nasal cavities but a condensing ostitis, more pronounced on the right side, did not permit the usual translucency of the maxillary and ethmoidal sinuses.

The orbits were decreased in size in both directions. The entire vault of the skull was markedly thickened with no uniform condensation of bone. The thickening, however, extended only outwardly, as the inner table was quite smooth, which explains the absence of any subjective symptoms. The thickness of the vault was about 2½ cm.

The base of the skull was also thickened irregularly, but no osseous tumors could be noted. The sella turcica was slightly smaller in size, but smooth.

The mandible was not affected nor were any other bones in the body affected.

Due to the fact that only the bones of the cranium were involved the author did not accept the diagnosis of Paget's disease. The pathological appearance of the radiogram did not agree with that of Paget's.

The point in the history regarding the prominence and enlargement of the superior maxillae ever since his youth, was in favor of the diagnosis of leontiasis ossea.

The authors review the scant literature on the subject, and refer to a few skulls, found in museums, which have been wrongly diagnosed leontiasis ossea. The authors discuss at some length the points of difference.

They have, however, found one skull which proved to be very interesting, as it was supposed to be a very ancient skull of some prehistoric human type. It was found at a depth of five meters in 1759 and given to the museum by Bernard de Jussieu. The authors found in that skull a true resemblance to their own case, the radiographic evidence of the similarity being very striking.

The paper is accompanied by four radiographs, those of the living case side by side with those of the supposed prehistoric fossil.

A. M. PFEFFER, M. D.

Tibiofibular Synostosis. Hans Rahm, M. D. Ztschr. f. orthop. Chir. 43: 64-69, January, 1923.

WHILE numerous reports have been made of cases of radio-ulnar synostosis (Kienboeck collected 36 cases in the literature in 1911), there has not appeared in the literature any report concerning tibiofibular synostosis.

The author's case was one of a 43 year old woman who came to be treated for a painful right knee. Examination revealed marked right genu valgum with absence of the normal prominence of the head of the fibula. There was some crepitation in the joint which was explained as due to arthritic changes. The roentgenogram showed some bending of the tibia, particularly marked in

the upper portion, in the reigon of the tibiofibular synchondrosis. The fibula was shortened, curved in its upper portion, and its head formed a synostosis, with the tibia joining it posteriorly and somewhat below the normal position of the head of the fibula.

The author applied Maass' theory of pressure on the epiphysis in the radio-ulnar synostosis to this case. While he admits that the condition may be hereditary in nature, or that it may be the result of some developmental defect, he is inclined to believe that the abnormality of the tibia was primary while the fibular anomaly was secondary and of mechanical origin. The constant pressure on the epiphysis of the head of the fibula, exerted by the faulty shape of the tibia, interfered with the normal growth and development of the fibula thus giving rise to the synostosis.

The author believes that a routine roentgen examination of all cases of genu valgum will reveal a larger number of synostoses similar to his own case, so that a better study could be made of its pathogenesis.

A. M. Pfeffer, M. D.

A Hitherto Unrecognized Disease of the Patella. Swen Johansson, M.D. Ztschr. f. orthop. Chir. 33:82-87, January, 1923.

FOUR cases are reported which occurred in children of 12 to 13 years of age with normal family history. These patients complained of more or less severe pain, in one or both knees, provoked by slight injuries. Examination revealed some swelling and tenderness in the lower portion of the patella. Roentgenograms revealed a few loose particles of bone around the tip of the patella, these particles having completely rounded contours without any indication of the presence of lines of fractures. some periosteal deposit was observed slightly above the tip, with swelling of soft tissues corresponding to the affected area. Two of the four cases showed similar changes in the tibial tubercles. The tarsal navicular bones were found to be normal.

Rest and splinting for several weeks brought complete relief of pain with full use of the knee. The roentgenograms then showed a mere thickening of the apex of the patella.

The navicular bones were examined because of Koehler's observation that in Koehler's disease (abnormal changes in the navicular of the foot) there may occur bone changes in the patella as well.

In discussing this abnormality of the patella the author finds it greatly resembles Osgood-Schlatter's disease which designation has been applied only to the tibial tubercle. Both of them present distinct circumscribed tenderness to pressure without any definite inflammatory symptoms. Both occur at the ages of 10 to 13 before ossification of the epiphyses. The prognosis and course of the disease is strikingly similar in both conditions. In both conditions the bone changes vary considerably, appear to be provoked by slight trauma, and localized about the insertion of a tendon.

The author discusses the possibility of these changes representing ossified particles within the tendon, and also the possibility, since some patellae have been known to have two ossification centers, of the pull of the tendon preventing union with the lower portion.

He summarizes the condition as being identical clinically, etiologically, and roentgenologically with that of Osgood-Schlatter's disease of the tibial tubercle.

A. M. Pfeffer., M. D.

A Case of Congenital Anomaly of the Spinal Column. George Wehner, M.D. Ztschr. f. orthop. Chir. 43: 123-126, January, 1923.

A RARE case is described of a child three and one-half years of age, who when presented for examination showed a marked sharp flexion of the spinal column, and club-feet. Incontinence of urine, difficulty in sitting up, general poor nutrition, and spastic condition of muscles of the legs were further complaints.

Roentgen examination revealed only rudimentary development of the first, second, and third lumbar vertebral bodies with complete absence of the arches of these vertebrae.

The author believes this case justifies the theory of Putti that the bodies of the vertebrae arise from different embryonal structures than their arches, and that there is some relation between the two so that one can not develop as well in the absence of the other.

The presence of club-foot in this case according to the author, is secondary to the malformation of the spinal column. Peltesohn and Beck have called attention to the frequency of spina bifida in congenital club-foot. The degenerative changes of the congenital defect of the cord or of the muscular nerves brought about the disturbance of the equilibrium and the club-foot condition. The spasticity, limitation of movement, and the urinary disturbance prove that it is of cord origin.

Therapeutically the correction of the club-foot, and the implantation of two bone grafts, one on each side of the column, should be attempted. A supporting corset should be worn.

A. M. Pfeffer, M. D.

The Secondary Effect of Scoliosis on the Internal Organs. Theodore Toepel, M.D., J. M. A. Georgia, 12:77, February, 1923.

THIS paper describes the effects as noted in the title and makes a plea for recognition by physician and educator of the early and mild changes which first accompany the deformity. If this were the practice structural changes need not take place and the pathology due to these would thus be prevented.

A New Lighting Arrangement for the Roentgenoscopic Room. E. Hoeger, M.D., Muenchen. Med. Wchnschr. 69:594, 1922.

IN THE red light ordinarily used in the roentgenoscopic room the adaptation of the eyes to the darkness undergoes considerable disturbance. The weak light of the screen is perceived by the rod apparatus of the retina, and as the specrum of this light contains the red rays it follows that the red light preceding the screen examination weakens the visual capacity for the screen light. So it is necessary to obtain a kind of light rays sufficient to visualize objects in the room, and which will not enter into the composition of the spectrum of the screen light. The author succeeded in producing a glass filter to envelop the source of light in the room, by which he accomplished the desired end. These filter glasses can also be used for adaptation eye glasses. They can be obtained from the firm of Koch & Sterzel, Dresden.

A. M. Pfeffer, M. D.

New Roentgen Ray Findings in Cord Tissues. Max Segalitzer, M.D. *and* S. Jatrou, M.D. Mitt. a. d. Grenzgeb. d. Med. u. Chir. 35: 598-610, 1922.

ONLY tumors of the spinal cord affecting the bony portions of the column, or bone tumors affecting the cord are usually believed to be demonstrable by roentgen ray methods. The authors, however, made the observation that certain tumors of the cord or of its coverings give roentgen ray signs. The following findings are described:

In nine out of ten extramedullary tumors, the roentgen ray examination revealed small exostoses in the edges of the vertebrae of a strictly circumscribed segment of the column. The remaining vertebrae and all other bones and joints of the body were entirely free from these findings.

Three of these nine cases showed sharp and pointed excrescences in the

edges of the bodies of the vertebrae at the level where the tumors were located. These tumors were found in the ventral position. In the majority of the dorsally placed tumors the exostoses were found somewhat below the position of the tumor.

Of five intramedullary tumors, four showed no excstoses. The case which showed exostoses had a tumor of unusually large size occupying the whole cervical region.

The authors conclude that positive roentgen ray findings (exostoses in the vertebrae of a circumscribed segment of the column in an otherwise normal column) may be considered contributory evidence of the presence of a cord tumor.

Negative findings do not exclude its presence.

If no definite diagnosis can be made regarding the location of the tumor from neurological examination, the laminectomy should be attempted at the level of the exostoses, and if not found there the laminectomy should be extended upward and not downward.

The paper is accompanied by a table containing the clinical and roentgenological findings, compared with the operative and postmortem findings, also by a drawing of the appearance of the exostoses.

A. M. PFEFFER, M. D.

A Simple Method of Treating Superficial Lesions of the Perineum and Intra-Pelvic Conditions from Below. Maurice R. J. Hayes, F.R.C.S.I., Dublin. Arch. Radiol. & Electroth. 27:249, January, 1923.

COMFORT, safety and simplicity are the merits claimed for this method which is made possible by the device described in the following paragraph from this article:

"Doubtless other radiologists have experienced similar difficulties in treating this region, but I have found the following solution of it to be so simple and so satisfactory that it appears to me worthy of note. It consists of an ordinary board fashioned like a lavatory seat, but having a circular opening four inches in diameter, which I place across the end of the frame of my radiographic couch, the top of which latter can be easily lifted off. The couch I use is the War Office pattern universal x-ray couch supplied by the Medical Supply Association. In this couch the tube box has longitudinal, transverse, vertical and rotary movements, with simple devices for carrying filters, lead glass nozzles of various sizes, and a pastille holder, and it is capable of very easy adjustment in all directions.

"When the patient is seated, the anal region, the perineum, or the vulva may be readily exposed. There is no risk of sparking to the patient's limbs, and there is no discomfort. A small opening in the seat is essential because it helps to keep the buttocks separated."

Radiotherapy of the Hypertrophied Prostate. Albert Perez, M. D. J. de med. de Paris, 42:36, January, 1923.

DR. PEREZ describes Nogier's technique for this treatment. The uncomfortable position which the treatment has heretofore necessitated Nogier has overcome by an ingenious piece of apparatus which holds the patient in a most comfortable position for as long as an hour at a time. The trunk and extremites are supported but the perineal surface is fully exposed.

Radiotherapy presents less inconvenience and risk than does surgery and is absolutely painless. By Dr. Nogier's method the seances do not last more than an hour and the necessary total dosage is soon accomplished. There is no risk of infection, no hemorrhage and no mutilation. The patient soon shows functional improvement and the more cheerful outlook which follows this has its effect upon the progress made. The surrounding parts are protected by a leaded glass device which permits irradiation of only the perineal parts, and suitable filters are of course used to protect against any radiodermatitis.

Because of the simplicity and efficaciousness of this form of treatment it should be tried before surgical intervention is employed, though this is necessary in rare cases where the fibrous tissue of the prostate is so abundant that it resists ray treatment.

The simplicity and mildness of radiotherapy for this type of disease the author believes will lead to its employment in most cases of malfunction of the organs of the urinary tract in patients past middle age.

Concerning Perirenal Insufflation. Drs. Chevassee *and* Moingot. J. d'urol. med. et chir., 13:54-57, 1922.

THE technique is not safe, and by no means free from risk and the roentgenograms obtained are difficult to interpret. One patient complained during insufflation of a sudden pain between the scapulae and of a choking sensation. The emphysema in the scapular region became palpable immediately. The path of the air movement was followed with the roentgenoscopic screen. It was seen to encircle part of the edge of the diaphragm, reach to the pericardial region and rise behind the sternum and clearly demonstrated the contours of the thyroid. The Corelli method (vertical puncture at a level of the second lumbar vertebra with the patient on the abdomen) often causes the gas to go through the psoas muscles.

The liver and spleen are often found in the area of insufflation. Marion, whose technique was carried out by Carelli himself, observed one case where the insufflation penetrated into the abdominal cavity, and one case where there resulted an emphysema in the neck region.

A. M. PFEFFER, M. D.

An Experimental Study of Various Chemicals Used in Pyelography. Oswald Swinney Lowsley, M.D. *and* Henry R. Muller, M.D., J. Urol. 9:1, January, 1923.

THIS article first briefly reviews the history of injections into the ureter and kidney pelves. Carelli's method is commented upon. The authors say that the injection of 200 to 600 c.c. of CO_2 into the perinephritic space is followed by absorption within one and one-half hours and is not accompanied by the great pain that so often accompanies pneumoperitoneum.

In the authors' use of sodium iodide no serious general reactions have been encountered in their clinical practice though they say, "Practically all cases upon whom a pyelogram is done suffer some discomfort due to the dilatation of the pelvis and ureter. This usually lasts only a few minutes but there may be a persistent ache for a longer period."

The method is thus described: "The patient is cytoscoped and ureters catheterized with lead catheters in the usual manner. Specimens are collected and sent to the laboratory to be examined bacteriologically (culture), chemically and microscopically. A phenol-sulphonephthalein test is then performed to determine the efficiency of each kidney before a pyelogram is done. Two radiograms are taken before the injection of the opaque material, one of the kidneys and upper ureters, and one of the bladder and lower ureter. Twenty per cent sodium iodide is then injected*** as soon as the patient begins to complain of a feeling of fullness some of the solution is allowed to run out and he is radiographed as above. A fifth radiogram is taken with the patient in the erect position * * *, the catheters having been withdrawn to the uretral orifices and sodium iodide injected during this withdrawal."

The authors have found sodium iodide, 20 per cent, more satisfactory as a medium than any other solution they have used. It casts a deeper shadow,

is non-toxic, non-irritating and is easily prepared.

Hydronephrosis, tumors, even very small ones, as well as small malignant ulcerations of the kidney pelvis may be detected. Renal malformation is easily detected. Stricture of the ureter is beautifully and positively demonstrated. It is of more frequent occurrence in both men and women than used to be supposed.

Stones in the kidney may or may not be revealed by the x-ray. "A large stone which does not cast a shadow in the radiogram will show a thinning out of the shadow of the pyelogram at that point. If a shadow occurs in the kidney region a pyelogram will demonstrate its exact position in relation to the pelvis and therefore may be of great assistance in determining whether operation is necessary or desirable."

Fever, subacute infection, or a great deficiency in both kidneys contraindicates pyelography. The aged, the emaciated, or those in a temporarily weakened condition are excluded from this form of diagnosis.

Perirenal Insufflation of Oxygen. Wm. C. Quinby, M.D., J. Urol. 9:13, January, 1923.

IN THIS paper and in the discussion following it the beautiful pictures secured by Carelli's method of injection of CO_2 are remarked upon but the difficulties of the technique are held out as a warning.

The author reports his own excellent results secured by the injection of oxygen. Details of his technique are fully given. He says that the operator with any reasonable powers of visualization and knowledge of anatomy should not encounter any such occurrence as mediastinal emphysema or penetration of the bowel. Untoward results have followed in only one case in the author's practice and were due to adhesions about the kidney, the result of a previous surgical operation.

Conclusions are: "First, that the method is of no danger in properly selected cases; second, that the technique of its production is relatively easy; third, that in certain instances it may be of definite aid in arriving at a diagnosis in properly selected cases, but fourth, that in the majority of cases stereoscopic pyelograms well made will give all the information necessary or obtainable by the further injection of gas."

Carelli-Sordelli Method of Renal Pneumoradiography. Drs. Delherm *and* Laguerrier. Presse. med. 30: 133-134, 1922.

THE ordinary roentgenographic methods fail to demonstrate the kidney shadow in 25 per cent of the cases, and even calculi can not always be demonstrated. Pathological changes can not be demonstrated in most cases. Carelli and Sordelli conceived the idea of air injection into the renal capsule in a manner similar to the pneumoperitoneum method.

The apparatus consists of two glass containers, connected by a tube, one contains oxygen or carbon dioxide and the other contains colored water. With the aid of a rubber ball the water is forced into the gas containing cylinder thus forcing the gas into a rubber tube connected to the lumbar puncture needle used for injection, the quantity of gas can thus be gauged accurately.

The technique is as follows: With the patient lying on the abdomen the transverse process of the second lumbar vertebra is found by roentgenoscopy and the needle is inserted immediately above and at the outside of the transverse process, slightly bent cephelad. The deep layer of the fascia lumbodorsalis is pierced. This is accompanied with slight resistance, the needle is then lowered for one or one and one-half centimeters and if the needle is in the proper position there will be oscillations of the manometer synchronous with respiration. One must be certain that there is no blood or pus in the needle lumen before it is connected to the gas container.

About 300 to 400 cc. usually produces a feeling of slight tension and is sufficient. The needle is then withdrawn, the patient placed on the back and roentgenograms made. CO_2 absorption is very rapid, so when one is not fully accustomed to the use of the method, oxygen is to be preferred.

The author found this method very useful in a few cases.

A. M. PFEFFER, M. D.

Roentgenography of Urinary Tract During Excretion of Sodium Iodid. Earl D. Osborne, M.D.; Charles G. Sutherland, M.D.; Albert J. Scholl, Jr., M.D.; and Leonard G. Rowntree, M.D., J. A. M. A. 80: 368, February 10, 1923.

THIS article reviews the use of various mediums in the urinary tract and gives in detail the authors' method of administering sodium iodid, and their roentgen technique.

Conclusions are thus stated: (1) "By the method described, it is possible to obtain roentgenograms of the urinary tract during the excretion of sodium iodid following its intravenous or oral administration. (2) The method uniformly gives excellent and accurate shadows of the urinary bladder and renders reliable information relative to its size, shape, and location. (3) It has been partially successful in depicting the renal pelves and the ureters in a limited number of cases. (4) In a number of cases it assists in revealing the kidney itself through intensifying the renal shadow. (5) It has been proved a success in revealing the existence of residual urine in the bladder and in furnishing approximate information of the amount, thus eliminating the necessity of catheterization and its attendant dangers of infection. (6) Oral administration of the drug will prove satisfactory for routine use in making roentgenograms of the bladder, while for shadows or the ureters and kidneys intravenous injection of large doses of sodium iodid is desirable."

Duodenal Motility. Homer Wheelon, M.S., M.D. J.A.M.A. 80:615, March 3, 1923.

THIS study was prompted by the finding by some experimenters that duodenal contents are normally regurgitated into the stomach at the close of gastric digestion and by the fact that reverse movements of barium are so often seen during radiographic examinations of the gastro-intestinal tract.

Corroborative evidence is required to complete the studies begun before it can be known whether they have any practical clinical or physiologic value.

The author summarizes his studies thus: "(1) Barium in quantities of from 20 to 60 c.c. may be injected directly into the duodenum without causing distress, the stomach and duodenum having previously been emptied of their contents. (2) The first observed movement of the barium following injection into the duodenum is a more or less complete division of the mass at the point of greatest distention. (3) Following the primary partial division, barium is usually passed along both directions of the duodenum, the central portion being delivered to the upper duodenum or cap, the distal portion to the jejunum. (4) Reverse movements of the barium sooner or later result in the complete filling of the cap, at which point barium may rest for a long period of time. (5) Following distention of the cap by reverse movements, barium is passed forward by progressive movements which at times carry material through the point of original duodenal distention to lower segments. (6) Barium may be delivered from the point of distention to the stomach as the result of reverse movements. In the majority of instances, barium is passed into the stomach only after several injections of the duodenum. (8) Barium tends to rest at the point of injection—inferior flexure. This region is the usual

point of injection. In one instance of jejunum injection, marked reverse movements resulted in the lodgment of barium in the cap, stomach, and inferior flexure."

Relation of the Heart, Pericardium and the Heart Valves to the Anterior Chest Wall. Leon T. LeWald, M.D. Arch. Surg. 6:89, January, 1923.

THE author in his discussion of the value of roentgenograms in diagnosis says the following: "In hypertrophy of the heart, the teleoroentgenogram is the best method of determining the amount of enlargement. When of extreme degree the findings are easily determined. When the question of minor degrees of hypertrophy or gradual increase of the size of the heart is the question to be determined extreme care in technique is necessary in order that the effect of respiration, displacement of the diaphragm, etc., may be taken into consideration. * * * In pericardial effusion, the roentgenologic examination is of great importance but the findings must be interpreted with great care. A case of calcified pericardium gave no physical signs indicative of the condition which was discovered in the fluoroscopic examination. Prior to any surgical procedure involving the chest a careful roentgenologic examination in various positions should always be made."

A Case of Primary Sarcoma of the Heart. L. G. Pinault, M. D., F. A. C. S., Canadian M. A. J. 13:108, February, 1923.

THIS is a case report of a primary round cell sarcoma of the heart in a woman 47 years of age. Postmortem revealed a tumor the size of a hen's egg which completely filled the right auricle.

Tumor of the heart may not produce any morbid symptoms unless it presses upon the auriculoventricular bundle of His, or unless it is so situated as to produce stenosis or regurgitation at a valvular orifice.

In the case reported there was edema of the legs, arms and trunk, greater in the right side than in the left. There was much free fluid in the peritoneal cavity and effusion in the right chest. The pulse was regular but weak; the heart sounds were regular but faint; respiration short and embarrassed; left lung apparently normal; right, dull to percussion with no breathing sounds. The mediastinal and heart shadows were larger than normal.

The author of this paper quotes the following from an article by Dr. I. Perlstein written in 1918: "Only 30 cases of sarcoma of the heart were found after complete search of the literature. To these is added a case in which the tumor originated apparently in the sub-epicardial areolar tissue. There is no characteristic clinical picture of the condition. The symptoms are mostly those of a seriously disturbed cardiac activity. Excessive and repeated hemothorax was the most striking clinical feature of the case reported. Sarcomas of the heart occur at all ages but are most common in the vigorous years of life. Histologically, all types of sarcoma have been reported. The spindle cell variety is the one most frequently found. They occur more often in the auricles than in the ventricles and more frequently in the right than in the left side. Among the postmortem findings pericardial and pleural effusions and edema are common."

X-ray Examinations in Cases of Brain Tumor. Daniel D. Talley, Jr., M.D. Virginia M. Monthly, 49: 639, February, 1923.

X-RAY findings may occasionally establish the diagnosis in a case of brain tumor but this is rare.

Bone tissue growths arising from the wall of the cranial bones and extending inward, pressure changes in the cranial bones, and very occasionally a partly calcified tumor may give definite roentgenographic evidence of tumor but diagnosis established by visualization of the shadow of a soft tissue growth without other roentgen evidence, though it has been done in a few instances, is not possible in most cases. Correct interpretation of the changed appearances accompanying tumor growth is the key to diagnosis.

Air injected into the ventricles followed by x-ray examination has sometimes been of value but is very dangerous and has in some instances been followed by death even when most expertly done. None but a skilled brain surgeon can do it and even then the risk is very great.

Conclusions: "The value of the x-ray as a factor in brain tumor diagnosis depends upon one or more of the following findings registered on the radiographs: (1) Actual visualization of the shadow of the growth itself or of a portion of the same. (2) Alteration in the appearance of the cranial walls or floor due to pressure. (3) Abnormality in the structure of a portion of the skull by reason of the fact that the tumor involves the bone or is attached thereto. (4) Evidence in the cranial walls of a growth which has involved the brain by metastasis. (5) Alteration in the appearance of one or more of the cavities of the brain, after the injection of air for the purpose of visualizing these cavities."

Personal Advances in Deep X-ray Therapy, A New Operating Table for Deep X-ray Therapy. Sinclair Tousey, M.D., Am. J. Electroth. & Radiol. 40:383, December, 1922.

THE writer records great benefit from x-ray treatment of cases of deafness due to atrophy of the optic nerve and plans a future paper upon the subject, in collaboration with Dr. Bell of the New York Eye and Ear Infirmary.

He says: "Tumors of the pituitary gland or of the brain or of the structures at the base of the brain call for the same methods, but with larger doses. Dr. Bell * * * and the present author will shortly report a case of tumor at the base of the brain which had caused blindness in one eye and great loss of vision in the other. Vision was restored in the second eye after deep x-ray therapy by the cross-fire method."

X-ray Treatment in the Diseases of the Ear, Nose and Throat. William A. Evans, M.D., J. Michigan M. Soc. 188:65, February, 1923.

THE writer says he states with confidence that radiation should play a prominent part in treatment of certain diseases of the eye, ear, nose and throat.

The results are not due to direct bactericidal action of the rays but to some bliochemical change wrought by the rays in the tissues.

There is not any danger to the neck glands if proper dosage is used.

The author's conclusions are as follows: "(1) Radiation through the upper respiratory passages has a definite action on the bacterial flora, as evidenced by sterilizaton of the throat, both as regards the Kloebs-Loeffler bacillus and the hemolytic-streptococcus and other organisms. (2) Cases of simple lymphoid hypertrophy both in the child and in the adult, should be treated by radiation rather than by the surgical removal of the offending tissue. (3) There is a type of lymphoid infection in which satisfactory results will be obtained only by the combination of the ultraviolet ray and the x-ray.* (4) Actively infected tonsils should be surgically removed. This includes cases showing the usual serious complications of tonsillitis, such as endocarditis, nephritis, acute arthritis, etc. (5) Little or no beneficial results are obtained in treating tonsils of the fibroid type. (6) Postoperative radiation will increase the percentage of surgical cures. (7) The stmulating action of the ray can be used to overcome low grade infections of the middle ear and also stimulate healing in the several areas.

*Reference is here made in the main ırt of the text to Pacini upon the comned use of x-rays and ultraviolet rays See Jour. Radiol. April, 1922).

ıdications for Radium Therapy in Ophtho-Otolaryngology. R. E. Loucks, M.D., J. Michigan M. Soc. 22:63, February, 1923.

DR. LOUCKS says that radium treatment is indicated and is speific in basal cell carcinoma which inolves the skin covering the orbit and ds of the eye, in epithelioma of the alpebral borders, in lupus vulgaris or osacea of the skin surrounding the palebral fissure, in sarcomas, carcinoma nd other tumors involving the orbit, in ernal catarrh, pterygium and slow ealing ulcers of the cornea or conınctiva. Relief is offered in trachoma nd "questionable benefit" in glauoma. Palliation is afforded in senile ataract. The cornea and the optic erve are resistant to the action of the amma rays of radium.

In treating the external ear or auditory canal caution must be exercised s the cartilage is extremely susceptible o the rays. In radium therapy of the niddle ear there is a possibility of bone ecrosis if improper technique is used. The author has found that chronic progressive deafness "is benefited in so far s the fibrosis of the external canal inensifies sound." He recommends radium treatment for chronic fistula folowing operation for mastoids.

The well known pathology of the oral cavity amenable to radium treatment he merely mentions but draws atention to the specific action of the beta ays on leukoplakia of the buccal mucous membrane. He recommends radium treatment for growths within the nares of either septum or turbinals, growths of the pharynx, nasopharynx and tonsils, and says that treatment with radium will prevent recurrence of polpi after surgical removal. Results of treating chronically infected tonsils without excessive hypertrophy are satisfactory in his practice but he has not had success with malignant growths of the larynx.

In treating papillomas direct application is used unless surgical treatment is employed, in the latter case preoperative and postoperative radium treatment is given.

Cervical adenitis, whether tuberculous or staphylococcic, responds to gamma rays of radium. He would radiate all cases of enlarged lymph nodes before tonsillectomy.

Cancer of the Larynx. Chevalier Jackson, M.D., Ann. Surg. 77:1, January, 1923.

THE term "precancerous condition" is used in this paper not in a purely scientific, histological sense, but in the sense of a condition which, while not malignant, is often precursory to malignancy.

Laryngeal irritation from any cause, chronic laryngitis, keratosis, syphilis, pachydermia, so-called prolapse of the ventricle, and benign growths when they occur in a person of precancerous age "may be contributory factors in the etiology of cancer and as such should be cured surgically or otherwise as may be indicated. * * * There will be fewer deaths from laryngeal cancer when every member of the medical profession fully realizes the frequently malign nature of chronic hoarseness."

A Skin Cancer Following Exposure to Radium. Ward J. MacNeal, M.D. *and* George S. Willis, M. D., J. A. M. A. 80:466, February 17, 1923.

THIS reports the case of a patient who was a physician in one of the leading hospitals and who worked with x-rays from 1905 to 1917, employing precautions for self-protection all that time. However, from 1912 to June, 1920, he had handled radium without any such precautions. Up until 1915 he used small quantities but from that time on he used large amounts and had habitually handled individual tubes of from 200 to 365 mg. between the right thumb and forefinger.

Various changes began to be observed late in 1918 and since early in 1920 the skin changes have required constant care. "In September, 1922, a fissure on the ball of the right thumb manifested a peculiar and extremely painful alteration in character, and on excision in October this lesion proved to be a squamous-cell carcinoma."

The authors attribute the growth to the exposure to radium.

Treatment of Leukemia by Means of the X-ray. Jackson W. Landham, M.D., J. M. A. Georgia 12:51, February, 1923.

THE term leukemia is here limited to the myelogenous and lymphatic forms of the disease.

Myelogenous leukemia is clinically made manifest by weakness, splenic tumor, secondary anemia, dyspnea, loss of weight, pain in the left hypochrondriac region in some cases, and a great increase in the total leukocyte count though the differential count may remain practically normal.

Lymphatic leukemia will show enlargement of the lymphatic glands, particularly the cervical and axillary ones, fever, weakness, hemorrhage from the mucous membrane of the nose, mouth or gastro-intestinal tract, also anemia and dyspnea. There is a great increase in the total leukocyte count and the differential count will show this to be due to an increased number of large and small lymphocytes.

All forms of treatment are unsatisfactory in this disease. Pearce, Krumbhaar and Frazier are authorities who say that splenectomy is contraindicated in the various forms of leukemia. Medical treatment with arsenic and benzol may bring temporary symptomatic and hemologic recovery for about a year.

The technique of x-ray treatment is described and five case reports are appended. Of these five cases one has retained a normal blood count since June, 1920, and pursues his usual occupation but requires treatment at intervals of from two to four months. Another patient has retained a normal blood count since May, 1921. Another was kept normal for a period of two years but upon the advice of friends went to another city for radium treatment, and died three months later. The other patients died, one two weeks after treatment was begun and one two months after.

The author's conclusions are: "(1) Blood counts are absolutely necessary in the diagnosis and for the indications of therapy in leukemia. (2) Surgical procedures in leukemia are contraindicated. (3) Medical treatment is of temporary benefit. (4) Radiation therapy produces beneficial resultss by a direct action on the blood cells and by forming leukolytic substances in the blood stream which have the power of lowering the white cell count. (5) Since the percentage of myelocytes does not seem to be reduced unless treatment is applied over the shafts of the long bones it would seem that the dualistic theory of the origin of leukocytes is correct."

The Role of Neoplasia in Parasitic Disease of Plants. Isaac Levin, M.D. *and* Michael Levine, M.D., Cancer Division of the Montfiore Hospital for Chronic Diseases. J. Cancer Research, 7:171, April, 1921.

THE authors' conclusions are as follows: "Neoplasia in parasitic diseases of plants, unlike the neoplasia in animal cancer always represents a protective reaction of the plant organism against the invasion of a parasite.

"Unlike malignant neoplasia in the animal, which has no finality and dies only with the death of the whole host organism, plant neoplasia always completes a life cycle. It has a period of progressive proliferation of undifferentiated cells, is frequently transformed into adult differentiated tissue, and then regression and death occur before the complete destruction of the host. Thus

it behaves more like reactive neoplasia in an animal than like animal cancer.

"Neoplasia in parasitic diseases of plants never represents a malignant tumor in the true meaning of the term in animal pathology.

"Neoplastic tissue in plants is constructed of only one type of cells and presents therefore an ideal material for the study of tumor formation.

"The true relation between the formation of reactive neoplasia and the pathogenesis of malignant tumors in the animal is as yet not established. The relation between infectious granuloma, Hodgkin's lymphoma, and lymphosarcoma—a true malignant tumor—presents an instance. The clearing up of this point may aid greatly in the establishment of the true etiology of cancer.

"The points considered in the previous paragraphs make it evident that the study of neoplasia in plants should become an integral part of all phases of cancer research, whether aiming at the elucidation of the etiology or pathogenesis of the disease or of the correct basis for therapy."

Radium Treatment in Cancer of the Cervix. Clark D. Brooks, M.D., *and* Wm. R. Clinton, M.D., J. Michigan M. Soc. 188:80, February, 1923.

THE factors which determine operability are grouped in outline form.

Preoperative x-ray treatment of pelvic lumbar glands, and hypochrondriac regions (both anterior and posterior exposures), and radium locally are used by this author. Two or three weeks later if laparotomy shows no metastases to the liver, lumbar and iliac glands a panhysterectomy is done. This is followed a month later by deep x-ray therapy and another treatment follows in three months.

In borderline cases sometimes radium or x-ray is used alone or combined in preoperative treatment and panhysterectomy follows in four or five weeks.

From 1200 to 3600 mgm. hours of exposure to radium are given.

X-ray Treatment of Uterine Hemorrhage and Fibroid Tumors. John S. Derr, M. D., J. M. A. Georgia 12:56, February, 1923.

A SHORT abstract is given of the fifteen articles reviewed. The first was published in 1904, the last in 1921. The authors are Foveau De Courmelle, Urquhart Bartholomew, Guilleminot and Lacquerriere, Bordier, Harnisch, Raymat of Barcelona, J. A. Corscaden, Kreutzmann, Beclere, L. Martindale, Pfahler, J. E. Panneton, I. W. Edem and L. Provis, A. A. Matthews, and George Shumaker.

The author of the review presents a brief report of forty of his own cases and describes the technique generally used.

Quartz Light Therapy and Its Relation to Preventive Medicine. Leo C. Donnelly, M.D., Am. J. Electroth. & Radiol. 40:390, December, 1922.

THE conditions which have yielded to ultraviolet therapy are listed as follows: baldness, acute ear infection, delayed convalescence after operation for mastoids, diphtheritic throats, septic sore throat (either aborted or duration of attack shortened), pyorrhea alveolaris, Vincent's angina, intestinal infections of diarrheic nature (quickly relieved) and pain of gastric ulcer. In his discussion of the relief afforded in pain from gastric ulcer the author cites a case of long duration, treated by a gastro-enterologist of international reputation. As a last resort before operating the latter referred the patient for ultraviolet treatment and was greatly surprised and gratified with the results as the patient's general health improved wonderfully after six months of combined medical and ultraviolet ray treatment.

The treatment has an anacid effect, a local sedative action upon nerve centers with a general tonic or systemic effect.

No claim is made for cure by quartz light but plus adequate medical care it is of great benefit.

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Roentgenologic Signs of Cancer of the Colon*

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ROENTGENOLOGIC diagnosis of cancer of the colon presents certain difficulties and apparently has not progressed comparably with the roentgenologic diagnosis of other diseases of the alimentary tract. It may be profitable, therefore, to review some of the accepted facts and summarize the findings in a series of 359 cases examined by the roentgen ray and operated on at the Mayo Clinic. Cancers of the rectum and rectosigmoid are not included in the series.

Pathology

From a pathologic standpoint, cancer of the colon offers few peculiarities. Histologically, the same forms are found as in the stomach, namely, the cylindrical-celled adenocarcinoma; the small-celled, soft, medullary form; the hard, scirrhous variety, and the mucoid or colloid carcinoma. Soft, medullary cancers grow rapidly, sometimes attain considerable size, and may slough deeply. Scirrhous cancers are often small, tend to encircle the bowel, producing the well-known stenotic, napkin-ring form, and are only superficially ulcerated. Most writers generally consider the flexures and narrowings of the colon to be the favorite sites of cancer; statistics indicate a marked predilection for the sigmoid flexure. Lane asserts that the common situations are at those points of the bowel where its lumen is constricted by acquired adhesions or by muscular spasm, namely: (1) in the ascending colon at or about the level of the crest of the ilium, (2) in the transverse colon to the left of the hepatic flexure, (3) at the splenic flexure, (4) in the descending colon at about the level of the iliac crest, (5) at the juncture of the pelvic and iliac segments, and (6) around the rectal sphincters.

Cancer of the colon differs from cancer of the stomach in that metastasis from the former is far less common. As pointed out by C. H. Mayo, the reason for this probably lies in the distribution of the lymphatics which are limited as compared with those of the stomach or small bowel. Necropsies have shown that in as many as 50 per cent of patients dying of malignancy of the colon the disease remains local, death being due to obstruction, perforation or peritonitis. However, in young persons the lymphatics are more active and there is earlier distribution of the disease; this is true also of cancer of the transverse colon.

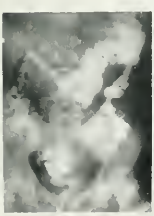
Technique

For eliciting roentgenologic evidences of colonic cancer, both the opaque meal and the opaque enema have been employed. Although the meal is still used to some extent, it has been largely superseded by the enema. The meal has the disadvantage of tending to accumulate in the proximal or distal portions of the colon, and repeated observation at intervals is required to visualize the intervening segments. The bariumized mass does not fill out a segment uniformly, but often strings out irregularly, or is broken up into detached masses. Haustration is present, but may be more marked in one segment than another; it is not uniform, and pathologic alterations of contour are not readily distinguished (Fig. 1). However, the meal may be used as an adjunct to the enema and may be an aid in the detection of cecal lesions.

Advantages of the enema are that it visualizes the colon throughout or to the point of obstruction, the colonic walls are expanded to normal or beyond, so that irregularities of contour are more readily seen, and it is possible to complete the examination within a few minutes (Fig. 2). Schlesinger says that since employing the enema he has often been able to demonstrate cancers with such slight symptoms that a malignant growth would hardly have been suspected.

For several years our routine at the Clinic has not varied. On the evening before examination the patient abstains from supper and takes 60 c.c. of castor oil; early the next morning he clears out the bowel with a warm soapsuds enema. The opaque enema is made up of 240 gm. of barium sulphate held in suspension by condensed milk and mucilage of acacia, the total quantity being about 2 liters. This is warmed to body temperature, and, with the patient recumbent on the trochoscope, is admin-

*—Read at the Annual Meeting of the Radiological Society of North America, December 5th, 1922, Detroit.



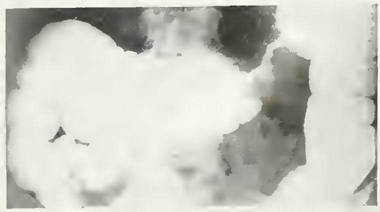



Fig. 1—(Case A-19406)—Ingested meal. Irregular distribution of barium throughout the colon. No definite obstruction, but peculiar irregularity of descending colon and sigmoid, suggesting a lesion. See Figure 2.
Fig. 2—(Case A-19406)—Definite obstruction to enema in the sigmoid flexure. At operation cancer of the sigmoid was found.
Fig. 3—(Case A-350027)—Cancer of the lower sigmoid. Note the annular filling defect.
Fig. 4—(Case A-68010)—Napkin-ring cancer of the transverse colon.

istered from a container at a height of 0.5 to 1 m. The enema is watched on the screen from the moment it enters until filling is complete, and the abdomen is manipulated as is necessary to assist observation. One or several plates are made for confirmation, supplementary study, or permanent record, but a diagnosis is never attempted on roentgenographic findings alone (Figs. 3, 4 and 5).

Roentgenologic Signs

Roentgenologic manifestations of cancer of the colon, as elicited by the opaque enema, are few and simple. Practically there are but two of importance, namely the filling defect and obstruction.

The filling defects observed vary widely in size and contour, depending on the size and conformation of the growth. Ordinarily, they are occasioned by the intrusion of the tumor into the intestinal lumen, but sometimes they are caused by infiltrative stiffening of the intestinal wall so that it does not expand under pressure of the enema, as does the adjacent uninvolved portion of the bowel. In some instances, also, the deformity is probably increased by local spasm excited by the lesion. Fecal accumulations proximal to an obstructive cancer may also exaggerate the filling defect.

Incomplete obstruction due to cancer may produce some retardation of the clysmal current at the point of stenosis. Unless there is also an evident filling defect at this point the examiner will not usually be able to distinguish this slowing of the enema from that which often occurs under normal conditions. Surgeons of the Clinic have observed that a marked stenosis may be found at operation even though the roentgenologist may not have noted obstruction to the enema. On the other hand, a stenosis which permits the fecal stream to pass in the physiologic direction may absolutely block the enema. One explanation of this eccentricity is that the stenosis is accustomed to the passage of the meal in the proper direction and accommodates itself accordingly; another is that the rapidly entering enema sets up a spasm which closes the already narrowed channel. The enema may terminate at the place of obstruction in a conical projection, or be rounded off bluntly. In the latter instance, as Schlesinger has shown, the actual site of obstruction may be concealed by the distended, overhanging end of the bowel; by changing the position of the patient, or by manipulation, the spicule-like termination may be brought into view.

If the stenosis is marked, but pervious to the enema, the bowel proximal to the lesion may show some dilatation, which is a natural sequence of the obstruction. Moynihan says that wherever the obstruction may be situated, the cecum distends to a greater degree than any other part.

Palpation for masses, although within the clinical field, is also a necessary part of the roentgenologic examination in order to determine not only their presence, but also their relation to shadowed changes in the colon. A mass corresponding to a filling defect, or a point of obstruction, increases the certainty that a lesion of the colon is present, although not necessarily a cancer. Furthermore, with the outline of the colon before him, the examiner can palpate with greater exactness than can the clinician. While the examiner thus has to deal with virtually the same phenomena as in cancer of the stomach, it is less easy to discover and to interpret them in the colon. The normal stomach has smooth contours, unbroken except by traveling peristalsis. The area to be studied is not extensive, is in plain view, and, by turning the patient, can be easily inspected at various angles, so that even relatively small lesions are not likely to escape notice. Gastric cancer has its simulants in syphilis, benign tumors, and simple ulcers, but the examiner can often exclude these with reasonable assurance.

On the other hand, the colon presents a far greater area for investigation. The pelvic colon is often more or less concealed by its own loops and is inaccessible to palpation because of the pubic symphysis. The rami of the flexures often cast an overlapping shadow. Slight local irregularities due to localized spasm, haustral tonus, external or internal pressure, are so common normally that it is unsafe to regard them seriously. Simulants of cancer are numerous and can seldom be dismissed from consideration on roentgen signs alone.

Interpretation

Given a filling defect, obstruction, or other abnormality, interpretation requires a careful process of exclusion. First, it must be assured that the signs are due to intrinsic, pathologic causes. Apparent filling defects may be produced by gas in the bowel or air introduced with the enema, or by pressure of the spine at the point where it is crossed by the transverse colon. After fillng the bowel the upper sigmoid is likely to show a hiatus, either from tonic contraction of the bowel or from pressure against the pelvic brim. Tumors outside the colon may indent its outline; manipulation will usually determine the fact. If the quantity of the enema is too small it may distribute itself irregularly; care should be taken that the amount is adequate.

Obstruction should not be too hastily assumed, for under normal conditions the enema often advances at irregular speed and is retarded somewhat at the flexures. Dilatation should be judged cautiously, and the normal greater width of the cecum and proximal colon kept in mind.

Spasm, the arch deceiver in gastric diagnosis, occurs also in the colon. More often it affects the distal portions which are so narrowed and deeply haustrated that the spasticity is apparent. Occasionally, the spasm involves only a limited area, is quite persistent, and the filling defect or narrowing which

Fig. 5—(Case A-283029)—Cancer of the cecum. Note the narrowing in the sigmoid due to spasm.
Fig. 6—(Case A-99125)—Spasm of the transverse colon near the hepatic flexure, simulating organic disease.

Fig. 7—(Case A-285818)—Tuberculosis of the cecum and of the ascending colon.
Fig. 8—(Case A-278991)—Actinomycosis of the cecal wall.

results is much like that of an organic lesion (Fig. 6). No mass corresponding to the defect can be felt and the enema is not obstructed at that point; these discrepancies may put the examiner on guard. Whenever spasm is suspected antispasmodics should be given to physiologic effect and the examination repeated. Usually the spasm will be relaxed by the drug.

When all such deceptive factors can be excluded and the existence of an intrinsic lesion is definitely established, the examiner can rarely venture an opinion that the lesion is cancer, for a number of pathologic conditions give similar findings. In the cecum and proximal bowel, tuberculosis, whether of the ulcerative or the hypertrophic type, often has a striking resemblance to cancer, although absence of tuberculous lesions from the lung has some exclusion value in the latter case (Fig. 7). Assmann remarks that it may be difficult to distinguish tuberculosis from cancer even at autopsy. Actinomycosis, appendiceal abscess and abscesses of the cecal wall may distort the cecal contour (Figs. 8 and 9). Typical, diffuse ulcerative colitis with its extensive involvement and its smooth, uniform narrowing of the intestinal lumen, will hardly be confounded with cancer, but if the condition is circumscribed in extent it cannot be distinguished from cancer with any degree of certainty (Fig. 10).

Peridiverticulitis is a vexing simulant of cancer. More often it is found in the sigmoid, or at least distal to the hepatic flexure, and is characterized by a local filling defect with perhaps a palpable mass and a few projecting, barium-filled diverticula. Often the deformity of the bowel is not due solely to the lesion, but is accentuated by spasm. Our observations with the roentgen ray accord with W. J. Mayo's statement that as a rule the obstruction from peridiverticulitis is not quite complete. Barium-filled diverticula in the distorted area, or elsewhere in the bowel, may aid in identifying the condition, but they are not always demonstrable. On the other hand, the irregularities of a cancerous lumen sometimes resemble diverticula. Further, 20 per cent or more of the cases of peridiverticulitis develop cancer (Mayo, Wilson). Thus an absolute differentiation is often impossible (Fig. 11).

In our experience, adhesions resulting from inflammatory disease or surgical operations, have not commonly caused either obstruction or evident deformity of the bowel. Indeed, the intestine may be well matted in adhesions without any definite changes in the roentgenologic picture. In a few instances, however, obstruction or irregularity of the intestinal outline from this cause have been noted (Figs. 12 and 13).

Besides cancer, the colon may be the seat of sarcoma, especially lymphosarcoma, or of various benign new growths. Primary sarcoma is rare, and, of course, occurs more often in younger persons. Benign tumors include myoma, lipoma, hemangioma, lymphangioma, and the tumor-like swellings incident to leukemia and pseudoleukemia. Obviously, the roentgenologist cannot be expected to distinguish cancer from any of them, but, notwithstanding their variety, the proportion of these cases to cancer is quite small. Polypose or papillary adenomas are more common. Usually they are small and multiple. Polyposis may extend throughout the small and large intestine, but its preferred location is the lower sigmoid (Mayo).

In one of the cases of polyposis apparent low obstruction was revealed at the first examination; on reexamination the bowel filled throughout, but gave a mottled shadow, not at all suggestive of cancer.

Intussusception may be a complicating factor of cancer. In a case examined with the roentgen ray by Karewski a cancer of the descending colon had caused an invagination into the sigmoid.

Lockhart-Mummery and others have emphasized the fact that in tumors of the colon the roentgenologic findings are often negative. In 9.2 per cent of the cases herewith reported the roentgen examiner failed to discover any signs of a lesion, a higher proportion of negative errors than in cancer of the stomach. The principal reason for this unfavorable comparison probably is due to the fact that a relatively minute alteration of the gastric outline is often a sufficient basis for diagnosis, while in the colon small irregularities are likely to be meaningless. Non-obstructive lesions in the pelvic colon, or at the flexures, may escape detection. Normal variations in the length and configuration of the cecum and ascending colon are sometimes hard to distinguish from pathologic changes. I recall one instance in which this part of the colon seemed rather short, but its outline was quite regular and the condition was regarded simply as a "high cecum." At operation a cecal cancer was found.

In deciding the question of operability, greater latitude is permissible than in cancer of the stomach. When the roentgen ray reveals an extensive cancer of the cardia, resection is seldom feasible. But cancers of the colon, however extensive and wherever situated, are not necessarily inoperable. Metastasis is often limited or absent. Attachment to a neighboring viscus, if conditions are otherwise favorable, does not necessarily forbid operation (W. J. Mayo).

Series of Cases

In the Clinic, from January 1, 1915, to the present, 359 cases of cancer of the colon which had been examined by the roentgen ray went to operation. Men outnumbered the women by more than two to one, with 242 of the former and 117 of the latter. While chiefly the middle and later decades of age were represented, it is noteworthy that no less than seven of the patients

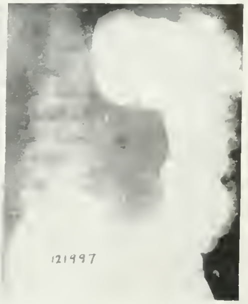


Fig. 9—(Case A-228330)—Appendiceal abscess deforming the cecal outline.
Fig. 10—(Case A-241349)—Localized ulcerative colitis of the splenic flexure.

Fig. 11—(Case A-270441)—Peridiverticulitis of the sigmoid.
Fig. 12—(Case A-121997)—Obstruction of the transverse colon by adhesions.

were under 30, the youngest being 20.

The cancers were in the cecum in 71 cases; the ascending colon in 44; the hepatic flexure in 28; the transverse colon in 50; the splenic flexure in 23; the descending colon in 39, and the sigmoid in 104.

In 54 cases the cancer was described either by the surgeon or the pathologist as of the annular type. Seventeen of the ring cancers were in the sigmoid flexure, and 37 were in other parts of the colon.

Metastasis to the lymph nodes or to other organs, principally the liver, occurred in 140 cases; in these instances the primary growth was in the cecum in 34 cases; in the transverse colon in 25, and in the sigmoid flexure in 36. Stated otherwise, metastasis occurred in 48 per cent of the cecal cancers, 50 per cent of those in the transverse colon, 35 per cent of the sigmoid cancers, and 31 per cent of those situated elsewhere. These data substantiate Mayo's statement that the cancers of the transverse colon rank first for metastasis, and apparently the cecal cancers are not far behind in this respect.

Adhesions were present in 146 cases, 40 per cent of the total number. Intussusception was noted in but five cases.

Notwithstanding the gross percentage of adhesions and metastasis, resection was feasible and was performed in over two-thirds of the cases.

In 326 (90.8 per cent) of the 359 cases the roentgen ray furnished evidence, usually emphatic, that a lesion of the colon existed. In virtually all the positive cases there was either a filling defect or obstruction, and often both.

Obstruction to the enema was noted in 78 cases, while the findings recorded at operation mention obstruction in only 70. It seems probable that in the excess number the growth had a valve-like effect against the enema.

In examining the colon it is our general rule to report the roentgenologic findings as such and not attempt a diagnostic interpretation. However, in 51 cases the examiner ventured the opinion that cancer was present, and in a smaller number he was content to report "lesion" or "tumor" of the colon. The opinion as to cancer was, of course, merely a fortunate prediction; the more conservative diagnoses were quite justified.

In ten instances a diagnosis of "diverticulitis" was made; possibly cancer had developed on peridiverticulitis in some of these, but the fact was not proved by the pathologist save in one case.

No signs of a lesion were observed in 33 cases, 9.2 per cent of the total number, and these were reported as negative. Of the cases which were negative by the roentgen ray, ten were in the cecum (14 per cent of the cecal cancers), 11 were in the sigmoid (10.5 per cent) and 12 were elsewhere in the colon (6.4 per cent). It is at first surprising to find the greater proportion of failures to recognize lesions in the cecum for this region is accessible to inspection and manipulation. Yet it must be remembered that the normal cecum varies as to breadth and configuration, and judgment between the normal and abnormal must be cautious.

No negative finding was reported in the cancers of the hepatic flexure or the splenic flexure, but in one cancer of the splenic flexure the examiner was doubtful and reported the case as "indeterminate." Notwithstanding this fortunate showing, it is easy to understand that non-obstructive cancers of these flexures may be overlooked, because of the varying normal contours and the fusion of the angles.

Of the 54 ring cancers, only one evaded notice by means of the roentgen ray, and obviously this form of cancer should be easiest of all to find. But the opportunity for examination is not always given; during the period covered by this study 30 additional cases of annular cancer were sent to operation without investigation by the roentgen ray, and it is fair to assume that clinical signs of stenosis were so marked that examination by the roentgen ray was superfluous.

Outstanding Impressions Gained From This Study

1. More than 90 per cent of colonic cancers will show roentgenologic evidences of a lesion when examined with the opaque enema.

2. A diagnosis of cancer cannot be made on the roentgenologic findings alone, for the condition is simulated by various lesions, and especially by peridiverticulitis.

3. Cancers of the cecum are more likely to elude observation by the roentgen ray than those situated elsewhere in the colon.

4. Ring cancers are easiest to find with the roentgen ray.

5. The exclusion value of a negative finding should neither be overestimated nor underestimated. In some cases the roentgen ray will fail to disclose a lesion, but not more than one in ten cancers should escape detection.

6. Roentgenologic examination of the colon in cases of cancer will not throw light on the question of operability, since the growth may be resectable regardless of its location, extent, or the presence of adhesions.

Fig. 13—(Case A-258202)—Filling defect in the sigmoid in a case of salpingitis with adhesions.

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Multiple Peptic Ulcers*

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PEPTIC ULCER is properly considered to be a single lesion. It is only rarely that more than one ulcer occurs at the same time. However, two or more ulcers may be present simultaneously, and, judging from the literature, this takes place more frequently than is commonly supposed. The multiple ulcers may all be in the stomach or the duodenum or in both places.

In the days before the use of the x-ray, the diagnosis was made only in the operating room or dead house. Now, at times, the x-ray enables us to make such a diagnosis with accuracy before operation.

Rokitansky states that among his 79 ulcer cases at autopsy, no fewer than 17 presented two or more open ulcers. Brinton in an extensive study concluded that two or more ulcers are present in one out of every five ulcer cases. In other words, about 20 per cent of the cases are multiple. He reported 463 cases of ulcer and 97 of them had more than one.

In the Mayo Clinic, in a series of 638 cases of gastric ulcers, 28, or 4½ per cent had more than one present. Fenwick, in an exhaustive study of the postmortem records, analyzes 867 cases as follows:

One ulcer present in 698, or 80.5%
Two ulcers present in 105, or 12.1%
Three ulcers present in 27, or 3.1%
Four or more present in 37, or 4.2%

These are all cases with active or open ulcers. If the scars of healed ulcers are also counted, then the percentage would run much higher, for ulcers heal and recur at the same or other spots in the same region. It is not uncommon to meet in the same stomach open ulcers and the scars of healed ulcers. Numerous ulcers are usually of the acute type, but when two or three are present, they are most frequently of the chronic variety. Most of the cases diagnosed by the x-ray and found at operation are of the chronic type. The number simultaneously present rarely exceeds five. According to Fenwick, chronic gastric ulcer is multiple in 13 per cent of all cases, while acute ulcer is multiple in 50 per cent.

Bolton states that acute ulcers occur chiefly in three types of cases (1) acute infective processes, (2) chronic infective processes and (3) where there is no obvious infection.

In the first group all the ulcers are in an open condition and scars are rarely seen, while in the second group it is not uncommon to find partially healed ulcers and scars together with recent ulcers. Acute gastric ulcer tends to recur and commonly heals.

Brin reports a woman 38 years old with two large chronic gastric ulcers and a third small recent one.

A contrast to these figures of the surprising frequency of multiple ulcers is a more recent report by Goldschmid of a review of 1,300 autopsies in Frankfurt. In this number there were 25 gastric and 21 duodenal ulcers, but in no case was there more than one found.

In rare instances, the number of ulcers present in the stomach is excessive. Hewitt reports a case with 60 ulcers in the stomach. Berthold mentions one with 34 deep perforations in the stomach. Osler reports one with 34 ulcers in the stomach, and Lange described one in which the ulcers were too numerous to count. The mucosa in such cases is riddled with small ulcerations. Usually such cases are associated with septic infections or secondary syphilis.

Ulcer in the duodenum is usually solitary, but it, like gastric ulcer, may be multiple. Merot found a single duodenal ulcer in 82 per cent, two in 13.5 per cent, and three or more in 4.5 per cent. Carman, in 1917, reported that in the Mayo Clinic, during 1916, 139 cases of gastric ulcer and 490 cases of duodenal ulcer were operated upon. In 16 an ulcer was found both in the duodenum and the stomach. In other words, 11.5 per cent of patients having gastric ulcers had duodenal ulcers also.

The histopathology of multiple peptic ulcers resembles that of the usual findings of the single duodenal or gastric ulcers. In the chronic duodenal ulcer there is usually a superficial destruction of the mucosa with moderate involvement of the Brunner's gland. However, there is practically no destruction of the underlying muscularis and serosa. There may be a lymphocytic infiltration of the adjacent tissue and a moderate endarteritis. Changes in the ganglion cells have been noted by several writers.

The chronic gastric ulcers usually present a quite different, although characteristic picture. The mucosa ends abruptly in the region of the ulceration and the borders are sharp and perpendicular to the floor of the ulcer. There usually is an entire absence of the mucosa, submucosa and muscularis at the site of ulceration. The floor of the ulcer is formed by granulation tissue and thickened serosa. There may be a definite subacute inflammatory reaction in the adjacent tissue with an associated arteritis and involvement of the ganglion cells.

In the acute ulcers the involvement is usually limited to the mucosa. It is in this type that an acute perforation is more apt to occur.

Moynihan has called attention to the fact that perforating ulcers are at times multiple and he advises that as soon as the ulcer first discovered is sutured a rapid survey of the whole stomach is desirable in order that any other ulcers may be laid bare. In a majority, the second ulcer was found on the posterior surface at a point exactly opposite the first.

It is difficult to make a clinical diagnosis of more than one ulcer for the symptoms are quite similar. The x-ray often establishes the presence of more than one ulcer. It is sometimes difficult to demonstrate a duodenal ulcer in the presence of a gastric ulcer, for, in the presence of an excess of hydrochloric acid, the pylorus may show spasm and the pain of manipulation may prevent a proper filling of the duodenal bulb.

It is important in all x-ray studies for ulcer not to be satisfied with the finding of one, but to look carefully for another in the stomach and duodenum. Small ulcers are very difficult to detect and are often missed unless an especially careful search is made.

CASE NO. 1

Female, age 54, consulted us in April, 1920. She complained of eruc-

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tations of acid, fluid vomiting, weakness and pain in upper abdomen.

The acute symptoms began eight weeks before and have grown steadily worse. At the outset she had eructations of a very acid fluid, and shortly afterward nausea and vomiting began. At first vomiting occurred one or two hours after taking food, but later even fluids caused distress. Later vomiting was more frequent.

Pain in the upper abdomen had been present the same length of time It was most frequently under the right costal margin and was referred to the back. The pain was sharp and gnawing. It was at first relieved by food and alkalies, but later only vomiting brought relief. Weakness and loss of weight became progressively worse. Constipation was present. The past history contained nothing of importance to the present trouble except that she had heart burn and eructations at intervals for years preceding the present trouble. There was no history of jaundice. The family history does not contain anything of note.

The physical examination revealed no abnormal findings in the nervous system. The pupils reacted to light and accommodation. The tonsils were small and ragged. The heart and lungs were normal. The abdominal wall was thin and flaccid. The liver was slightly enlarged and firmer than normal. There was some tenderness over the gall-bladder, but it was most marked over the epigastrium and here the abdominal wall was rigid on palpation.

The blood showed 3,600,000 red cells, 9,000 white cells, and the hemoglobin was 75. The Wassermann test was negative. The urine was negative. The stool showed occult blood. The stomach test showed free HCL 15, total acidity 35. The test for occult blood gave a marked reaction and sarcinae were present in large numbers.

The x-ray study made by Dr. Jenkinson did not show any evidence of gall stones. The stomach was large and dilated. There were two penetrating ulcers in the lesser curvature, involving the pars media (Fig. 1). The pars pylorica was irregular and could not be filled. The duodenal bulb was normal. The emptying time was markedly delayed. At the end of 24 hours the stomach was more than half full.

Fig. 1

Fig. 2

At the operation, which was done by Dr. McArthur, the two penetrating ulcers were found, and these were resected and the stomach anastomosed to the jejunum. The gall-bladder was found full of stones and the entire gall-bladder was removed.

The patient made a good recovery.

Case No. 2

Female, age 43, was referred for consultation by Dr. Getty in 1920, and it is through his kindness that we are making this report.

She complained of epigastric pain at times, relieved by food and alkalies. There was no nausea. Tenderness was present in the epigastrium. The stomach contents showed 28 free acid and 38 total acidity. The x-ray showed deformity of the duodenal bulb. She was given medical treatment for ulcer by Dr. Getty and left the hospital feeling well. Three months later the symptoms returned, and the x-ray showed a similar duodenal bulb deformity and an irregularity of the lesser curvature of the stomach (Fig. 2). A little later hematemesis occurred.

She was operated by Dr. McArthur. An ulcer located on the upper third of the lesser curvature was resected. A gastro-enterostomy was not done.

Two months later all the symptoms returned with greater severity. Medical treatment was tried again without avail and she consented to another operation by Dr. McArthur. A posterior gastro-enterostomy was done. She remained well for six months and then symptoms returned and she began passing tarry stools, and a few weeks later vomited blood, and this was repeated and five transfusions were necessary.

Another x-ray study showed an ulcer on the lesser curvature with spastic indrawing of the greater curvature opposite, and deformity of the bulb and pylorus. There was marked delay in the emptying time. Dr. Richter did an anterior gastro-enterostomy, but the patient has not been entirely comfortable since that time.

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The Relation of Roentgenology to Urology*

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"LET YOUR LIGHT so shine" —I feel that mine, midst the highest powered illuminators and deepest penetrators of this country, shall glimmer as a mere candle. Portia, though she said that "the greater glory doth dim the less" also said, "How far that little candle throws its beams; so shines a good deed in a naughty world." So, perhaps, some ray of light may be emitted in my discussion of the mutual relationship of roentgenology to urology.

Let me preface my remarks further by stating definitely that I make no pretence of familiarity with the intricate mechanics of radiography, but from my intimate association with this branch of medicine over a period of fifteen years I feel that I am at least fairly competent in the interpretation of its results as applied to my special line.

In the very beginning of my practice I was closely affiliated with your president-elect, Dr. Carman, and through daily contact with him I began early to see the enormous benefit to be derived from the close association of these two branches of medical effort. Under his tutelege I gained much valuable information which has been greatly augmented during the recent years by intimate relationship with Dr. Ernst and Dr. Sherwood Moore.

Throughout the development of urological surgery there has been one feature permanently prominent, that is that accurate diagnosis is the fundamental factor for properly directed surgery. Such a diagnosis is impossible unless there be this co-relation between roentgenology and urology. Their dependency upon each other is so vital that I feel that no one is equipped to do accurate scientific urological investigation without this alliance. This means not neighborhood proximity, but an absolutely direct proximity. One must either adjoin an x-ray expert or have a trained technician of his own and be capable himself of personally interpreting the results of the radiological examination.

For this reason, I installed an apparatus of my own, and I have been so remarkably impressed with its great value that I would feel materially handicapped without it. There is scarcely an urological investigation, no matter what may be the nature of the condition, that does not require roentgenological aid.

Urology is the father of surgery. In pre-historic times, urological operations were performed, but were crude in character and usually unfortunate in results. The first authentic operation was done by Celsus, centuries ago. Throughout a long period of years until the middle of the nineteenth century, operations upon the urinary organs were exceedingly rare and were always exploratory, owing to the lack of facilities for scientific study, and not until the middle of 1861 did Walcott operate for renal tumor. The first lumbar nephrectomy was done by Simon of Heidelberg, in 1869. It is interesting to note that the first operation on the urinary organs was for calculus. It is for this particular condition that we owe your important branch of medicine an everlasting debt.

In the early part of the nineteenth century, we find Bozzini presenting an endoscopic tube through which he reflected light into the bladder as a means of diagnosing diseases of this organ. His instrument and theories were not accepted until 1853, when Desormaux was able to convince the professional world of the actual results of such an instrument. Very little was done, however, until Nitze in 1877 presented his lens cystoscope with a lightning attachment; modifications were made, and in 1886, with the addition of incandescent lamps, the cystoscope became the creator of this branch of medicine. Our profession owes a great deal to this genius for his marvelous discovery.

Many men presented modifications of this instrument, and improvements were gradually made by Brenner, Leiter, Tilden Brown, Lewis, Buerger, Casper, Allbarran and others, until these instruments finally reached their acme of perfection about the year 1910. Since then the cystoscope with a proper interpreter gives the most accurate estimation of the interior of the bladder and allows a comforting surety of an exact diagnosis of its many pathological conditions. But that is not all. With only the cystoscope, the largest field of urology, namely the upper urinary tract, would be in a phase of bewilderment. This has been obviated by Simon's discovery that the ureters were possible of catheterization. His important discovery, while impractical and crude, because it was done blindly and with such attendant danger, stimulated Kelly and Pawlik to the scientific investigation of the upper urinary tract through the ureter catheter by means of the cystoscope. This was first done with a hollow tube, by reflected light, in the cystoscopy of a female patient in 1888. At first the difficulties were naturally pronounced, but with modern instruments this process has been so simplified that it requires but a few seconds or minutes for its performance.

Diagnosis improved with the development of these cystoscopic instruments, and surgery of the urinary organs became more and more frequent, yet the knowledge of diseases of the upper urinary tract was still clouded with confusion. Then came the bright light on the horizon of urology, when the wonderful discovery of Roentgen met its first application to this branch of medicine. As far as I am able to determine, the first authentic radiographic application to renal surgery was made by McIntyre of Glasgow, in July, 1896, by means of a roentgenogram obtained with a six inch spark and a twelve minute exposure. There was recorded an elongated shadow in the kidney, which was diagnosed as stone, and Adams of Glasgow operated and removed it.

Other observers, among them Swaine, late in 1896, Loewenstein and Fenwick in 1898, Bruce about the

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same time, and Bevan, McArthur and Leonard became interested in roentgenology.

Fenwick, in 1897, was the first to successfully take a radiogram showing the outline of the kidney. In a radiogram of a kidney stone, he remarks that there is a perfect outline of the kidney shadow. This led to the greatest advancement in urology since the discovery of the cystoscope. Fenwick was also the first to fluoroscope an exposed kidney for the detection of calculus, a method which has been put into practical application by the Mayo Clinic and one so extremely important that it should be routinely employed in all cases of upper tract calculi.

It was soon found that these two methods of investigation when utilized individually were unsatisfactory, for neither one alone sufficed to establish an accurate diagnosis. As early as 1897, one finds Tuffier passing an opaque catheter up the ureter and simultaneously taking an x-ray picture. In 1901 Schmidt and Kolischer independently published radiograms showing the position of the ureter and the situation of the renal pelvis. This was followed by reports from Loewenhardt and Von Illyes. It was in 1905 that Fenwick suggested the use of the ureteral bougie with its walls impregnated with metal. This simultaneous application was an advancement in the localization of urinary calculi, but very shortly it was found that this was not adequate and Klose suggested the injection of bismuth into the ureter and pelvis of the kidney with simultaneous radiography. This method failed because the shadow was uncertain and the bismuth difficult to remove, but its principle was correct and stimulated one of the notable advances in urology, namely, pyelo-ureterography. Voelker and Lichtenberg in 1906, by means of collargol injections perfected this method. From this time on, the simultaneous application of ureteropelvic filling combined with radiography has passed through many hands until it is now as accurate a method of diagnosis as exists in any branch of medicine.

I shall briefly mention, by way of history, some of the contributors to this procedure, which at the present time finds a universal application.

Keyes in 1909 suggested argyrol, Uhle and Pfahler suggested electrogol. Burkhard and Plano in 1907 first suggested the injection of oxygen into the pelvis. Lichtenberg, Dietlen and Cole also commended its use. The gaseous medium did not meet with widespread acceptance, and later in 1913 we find that Uhle, Pfahler, Kelly and Lewis suggested silver iodide emulsion. While these methods were of diagnostic value, they were not without untoward effects and several deaths from emboli and occasional severe renal reactions followed. For this reason, therefore, Burns presented thorium nitrate, which has been used for a number of years because of its more acceptable qualities, in that it does not stain, is not irritating and does not cause the disagreeable features of the silver salts. Recently sodium bromide has supplanted the other media and is almost universally used. It is non-irritating, casts an excellent shadow and is inexpensive. Pyelography has been popularized and put on a substantial basis by the untiring efforts of Braash, to whom the greatest credit should be given for this phase of diagnosis. In repeated articles on this subject, he has given diagnostic data of most of the diseases of the kidney and ureter.

I shall not take your time to discuss the method or procedure, except to say that I am thoroughly convinced in my own mind that the syringe method with rubber bulb is the safest, in that steady pressure can be made, accurate filling accomplished and immediate aspiration done in case of pain. I, personally, see no advantage to the gravity method. Pyelography, of course, is not without dangers; but with careful technique troublesome complications should be extremely rare. The media should be non-toxic and non-irritating and should be thoroughly sterilized. There should be gradual, steady filling with the ability to aspirate, and regulation of pressure with the cone, which should always be placed before the pelvis is filled. One must refrain from this procedure if there are contra-indications, such as fresh hemorrhages, infected retentions, severe vascular diseases and renal insufficienties. Let me particularly call your attention to the inadvisability of giving sedatives preceding pyelography, since they may mask sensation and create a tendency to overfilling.

Gradual development has brought our two specialties more and more closely together, until at the present time they may well be called the Siamese Twins of Urology. In practically every disease of the kidney and ureter, and in a great many diseases of the bladder and prostate, the use of x-ray is indicated.

From a clinical standpoint, it should be applied to the five cardinal signals of urinary disease, viz: in every case of abdominal pain or pain in the back; all cases of blood or pus in the urine which are not of venereal origin; all cases of bladder irritability not definitely ascribed to gross lower tract obstructions, and in every indefinite abdominal mass.

X-ray finds its most valuable field in urinary lithiasis and without it an exact diagnosis cannot be made in the upper tract. Diagnoses can be made with it which are unattainable in any other way, for instance, when cystoscopy is impossible. Through it a tentative urological diagnosis can be confirmed or denied. This is its most valuable field, since here the greatest degree of accuracy is obtained when it is simultaneously employed with urological methods of investigation, namely, ureteropyelography and cystography. If habitually employed, many unsuspected discoveries may be made.

Method of Procedure

In any of these five indications, my routine is about as follows: After a cystoscopic study of the bladder, catheters are passed into the ureters, though occasionally conditions found in the bladder make this unnecessary. While the specimen is being secured from each kidney and the function is being determined, a complete radiographic series is taken of the kidneys, ureters and bladder. One should never short cut by taking one kidney or both kidneys, but since symptoms may be deceptive, and furthermore, since there is so frequently an associated bilateral lesion, the whole tract must be observed, as was first called to attention by Contremoulens in 1907. Various preparatory methods have been advocated, consisting chiefly of thorough catharsis and restriction of certain foods, but from my personal experiences, particularly with routine ambulatory cases, the less the intestinal churning with cathartics, the better the plates.

It has been my custom to take a three plate series, one for each kidney, one for the lower ureters and the bladder. It is seldom necessary for a five plate series, at least on the first study. The one large plate technique has not given satisfactory details in my experience and the simultaneous radiography of the two kidneys is not as a rule satisfactory, since it misses the chief essential in renal picturing, namely, extreme fixation.

The plates are immediately developed, and if they are not perfect, or if there are suggestive findings, they are retaken. I do not consider a perfect plate one that shows the psoas muscle, the last ribs and the spine, but one which shows the kidney in its entire outline, as has been suggested by Dr. Carman.

Following this, depending, of course, upon what has been found in the specimens and in the function, either a unilateral or bilateral pyelogram is made. Bilateral pyelography has met adverse discussion, but under very careful control it seldom causes any trouble, provided the ureter catheter is left in place where immediate aspiration may be

done if necessary. I never fill both kidneys simultaneously, but individually.

The suspiciously diseased or definitely diseased side is filled first and if there are no contra-indications, the supposed normal side is done very carefully. In case of ureteropyelograms where one is dealing with hydronephrosis (which, of course, has been previously detected by the insertion of the catheter into the pelvis with determination of retention), bilateral pyelo-ureterogram is a more serious problem and should seldom be done at the same sitting.

In large hydronephroses, it is essential that the pelvis be thoroughly drained before pyelography, since many of the poor plates in such instances are due to dilution of the media with the products of renal retention.

Pyelograms are then developed, and, if satisfactory, the patient is drained and given a pelvic antiseptic injection and allowed to go. If the plate is not satisfactory, there is a retake, unless there be contra-indications, but these are seldom. I use 15 per cent sodium bromide.

The interpretation of pyelograms is extremely important and requires considerable experience. The typical hydronephrosis, pyelonephritis or renal tumor needs no particular keenness of perception, but the frequent variations found in pelves showing filling defects and distortions need the most careful scrutiny. Here we must never forget that we are dealing with a surrounding muscle which is physiologically possessed with the power of contractibility and susceptible of spasm, which is capable of producing such changes without underlying pathology. The release of spasm, either spontaneously or with atrophin, will upon a check filling, often reveal a normal outline. Such pelves are frequently interpreted to have tuberculosis, tumor and the like, and it is only with repeated study and correlation with urological findings that the exact diagnosis is possible.

By this method, the exact location of renal and ureteral shadows can be determined and the differentiation of urinary from extra-urinary shadows can be made. In certain cases, of course, particularly the lower pelvic shadows, either stereoscopic ureterograms or the simultaneous snapping of two pictures on the same plate at a different angle, as called attention to by Kretschmer, may be necessary.

If there are evidences of hydronephrosis a picture taken in the prone and upright position should always be done to determine the degree of renal movability and torsion, and the presence of ureteral kinks, twists and strictures.

Innumerable instances could be cited of the remarkable value of this close affiliation of the x-ray and the ureteral catheter. Two recent impressive lessons will serve as illustrations.

Two individuals presented themselves who had been treated for pyelitis by innumerable pelvic lavages for many months without improvement, both had had repeated x-ray plates with negative findings. Our x-ray pictures taken with catheters in place showed in both instances that the catheters curled up in the ureter and an ureterogram showed that the ureters in both were enormously dilated, due to obstruction at the ureterovesical valve. They were both cured by incision of the ureterovesical valve with the relief of the obstruction, one by means of the operating cystoscope and the other by a new operation which I have just described for intravesical transposition of the ureteral orifice.

Let us then discuss some features of the x-ray as applied to the study of the five essential points previously described.

Every case of abdominal pain should be rayed, unless it shows itself very definitely to be an acute abdominal condition needing immediate surgery. In a rather large series of kidney cases which we studied several years ago, 27 per cent of renal and ureteral stones had had previous appendectomies without relief—an x-ray could have saved this misdirected surgery, since the x-ray is capable of showing the great majority of ureteral and renal calculi. The diagnostician should less habitually frequent the smooth pavement lining of the peritoneal highway and direct his meanderings more often to the stony gutters in the rear.

There are, however, several warnings. It has been varicusly estimated that two to five per cent of cases are shadowless. I believe, with thorough study, good plates, and repeated plates, that the figures should not exceed two per cent.

It is in this particular type of case that the roentgenologist must be extremely guarded. I feel that the expression, "The x-rays are negative," should not be used. I will explain my meaning. A physician sends to the roentgenologist a patient with a history suspicious of stone, the patient suffering with what seems to be renal colic. X-rays are taken, the plates show no evidence of stone and the roentgenologist reports that the x-rays are negative. This conveys to the practitioner's mind the fact that the kidneys are not the cause of the pain. I have seen this many times. The roentgenologist should say that the x-ray *shows no definite evidence* of renal or ureteral stone. In this way, the mind is not diverted from the kidney. So many kidney and ureteral conditions may be responsible for the same type and character of pain as is imposed by stone, and yet they may cast no radiological evidences of disease. The most important of these conditions are hydronephrosis from kinks and renal movability and from aberrant vessels, stricture of the ureter, hydro-ureter from obstruction at the uretero-vesical valve, hydro-ureter from regurgitation from the bladder, due to a patient ureterovesical orifice, srystal showers, shadowless calculi and central nerve crises. It is only by the use of the x-rays with urology that these conditions can be determined.

It may surprise you also to know that in a fair series of cases, on which renal fixation was done for the relief of pain due to such causes, 30 per cent had had previous appendectomies and 10 per cent previous gall-bladder operations without relief. This is the most insidious type of kidney pain because of its negative urinary and radiological findings. We are learning more and more that vague renal pains are due to obstructions in the lower ureter, hence the great importance of ureterograms.

We must also be cautious in the case of what seems to be typical renal pain associated with a few red blood cells in the urine, with negative x-ray findings for calculus and definite ureteropyelographic evidences of either tortuosity or kinks of the ureter with or without hydronephrosis and ostensible indications for renal fixation. Such conditions, however, rarely cause scattered blood cells in the urine; if bleeding occurs, it is profuse. In my experience such a symptom complex has always been relieved by the passage of a small shadowless calculus.

It should furthermore be definitely understood that no one should ever operate for calculus of the upper urinary tract upon x-ray findings alone. I have seen many instances of shadows, seemingly typically renal, which proved by thorough examination to be either gall stone, gland, enterolith, calcification of a tuberculous focus or calcification in a renal tumor.

To illustrate how important it is to be ultra careful,—a woman appeared with an x-ray plate which showed a round shadow in the right kidney region, dense and white, giving every evidence of a renal calculus. She had consulted her doctor on account of profuse hematuria and pain in the right upper quadrant. She had been given the diagnosis of right renal stone and was told to have the kidney explored. When she came to me, I found her bleeding from the other kidney. The kidney in which the shadow seemed to be was entirely negative, pyelogram was

normal, the shadow was movable and proved to be a gall stone.

In case there is a definite coral, branched stone, where the chance of diagnostic error is negligible, urological study must be done in order to determine the function of the kidney and more particularly that of its mate, in order that proper surgery may be executed.

In ureteral shadows, the condition is even more complicated and no suspicious ureteral shadow should ever be surgically sought until it has been definitely studied by combined radiography and cystoscopy. The old idea that the ureteral stone operations were extremely difficult was due to the fact that the stone was not present. When the stone is there the operation is usually simple.

There are certain classical zones of election for stones, pheboliths and glands, but atypical shadows occupying the border line positions defy exact diagnosis in the hands of the most expert roentgenologist.

The x-ray is assuming a valuable place in tuberculosis of the urinary tract. It frequently shows areas of calcification in the kidney and occasionally a complete calcification of the organ as brought out by Colston and others. I have had six such extreme cases. Rarely it shows the outline of the ureter. In one case, a young girl, the x-ray showed a complete outline of the kidney and ureter, the ureter being as big as the finger. The patient had been treated for hip disease, owing to contracture of the psoas muscle, due to implication of the ureter. Nephroureterectomy cured the limp.

Coupled with pyelography, advanced tuberculosis gives a definite picture not seen in any other lesion, namely, fringy irregularities of the pelvic and ureteral outline. In early lesions, there may be polar aberrations, filling defects and salyx constrictions, which with urinary findings, establish the diagnosis.

Such findings are frequently encountered in cases of bladder irritability.

Abdominal masses are definite indications for roentgenological study. The x-ray will occasionally show calcifications in a renal tumor or enlargement of the kidney. With pyelography, one can almost invariably say whether a mass is or is not renal. One has to be particularly careful in interpreting the size of a kidney by means of x-ray pictures. I have been personally deceived in many instances. My first attention was called to this in the case of a floating kidney, the shadow of which was extremely large on several x-ray plates. At operation the kidney was really smaller than normal, but encased in a large amount of perirenal fat. The mere fact of extreme deflection of the ureter catheter either inwardly or outwardly is not indication of an extra-abdominal tumor. I have seen such deflections from large gallbladders and bowel growths.

In congenital lesions of the kidneys and ureters, it is only with the combined employment of our two paraphenalia that we can arrive at a satisfactory diagnosis.

I shall spare your time in discussing anomalies, except to say that they are frequent findings and now occupy an important chapter in urology, since we have investigated them together. A few words might not be amiss in discussing the importance of systematic combined study, in the detection of the ectopic kidney.

Of three cases which I have encountered in the last few years, two presented lower abdominal masses associated with abdominal pain and evidences of infection, both were diagnosed appendiceal abscess, both had pyuria. Cystoscopic examination showed pyonephrosis in both instances with low function on the corresponding side.

The catheters went to a normal distance without any appreciation of obstruction and no suggestion that the kidney was in an abnormal position. Both gave indications for nephrectomy and had not the combined study been made a lumbar exploration would have failed to show the kidney. In both instances the catheter curled up in front of the promontory of the sacrum, such a position demanding a lower abdominal incision.

The other case was a unilateral fused ectopic kidney which required suspension. The value of roentgenology in diseases of the bladder is much more limited than in diseases of the upper urinary tract. It plays chiefly a cooperative role and except for cases which do not permit cystoscopy, and they are extremely rare, and in stones incarcerated in diverticuli, it possesses doubtful value when used alone. The cystoscope is so much more certain in the diagnosis of vesical calculus, since it not only visualizes the stone, but allows proper interpretation of associated vesical conditions.

One must know the type of vesical orifice as well as the presence of the stone and whether or not there are sacculations, diverticuli or tumors of the bladder. About 50 per cent of the stones may be crushed, provided they are not back of gross obstructions. The small obstructions may be removed by endovesical operations after litholapaxy, but in the gross obstructions, the stone forms an integral part of the operation for obstruction.

Cystography, however, has a valuable field in that it will show the shape, size and position of the bladder and changes in its contour, particularly at its internal orifice. Its most valuable field of application is in the bladder diverticulum, whereby the exact size and relation can be determined, as by no other method. It furthermore gives valuable information in carcinoma of the bladder in showing filling defects and indentures, particularly at the internal orifice. Often cystoscopically it is impossible to definitely determine the amount of orifice involvement. If such defects are detected, it is a pretty safe indication that partial resection is out of the question.

In the neurogenic bladder, there is often a definite funneling at the internal orifice. It provides another diagnostic service in this type of bladder in detecting spinal column defects such as are seen in spina bifida occulta and offers an occasional explanation for the incontinent bladder of children.

Regurgitation from the bladder up the ureter due to inability of the ureterovesical orifice to coapt has been illuminated by this method. Through it we have learned to explain many of the ascending kidney infections. Through it we have also learned to appreciate the importance of congenital valve obstructions and contractures at the internal vesical orifice, which were otherwise indefinite.

In the prostate, as in the kidney, the x-ray serves its most important mission in the detection of stone. Prostatic stones are usually discernible by radiographic means and such stones need recognition, since they are frequently the cause of chronic infections in this organ. They are usually multiple and small, but occasionally quite large. I removed one about a year ago, the size of a large walnut. Successful prostatic picturing depends greatly upon technique, owing to its anatomical position in the anterior segment and directly behind the symphysis an anteroposterior plate is seldom satisfactory. The oblique posteroanterior position is necessary. The plate is placed under the genitals and the cone obliquely posed upward against the coccyx, in this way the shadows within the prostate are deflected above the symphysis and not obscured by it.

If the x-ray shows a definite shadow of the whole prostate, one should always be suspicious of carcinoma. I have seen it in several cases of cancer of the prostate, but do not recall having seen it in any other condition.

One frequently encounters difficulty in differentiating the cause of backache; chronic infections of the prostate and vesicles are very often responsible, but one can never be certain, unless protected by a picture of the sacro-iliac joint and lower spine.

Even in rare penile lesions the x-ray is of service, particularly in Pyronnes' disease or induration of the shaft it enables us to determine the presence of calcification.

Aside from its superb diagnostic qualities, which have aided so much in the advancement of urology that our debt can never be paid, the x-ray is assuming an important function as a therapeutic agent in the palliation and in certain cases the cure of malignant tumors of the genitourinary tract.

I shall speak but very briefly on this phase of the subject, as I am not thoroughly convinced in my own mind of its real value. I am however confident of curing an enormous extrarenal gland metastasis, following a nephrectomy for cancer of the kidney which I did five years ago. The mass surrounding the deep vessels was as large as a big orange. A section of this mass showed cancer. Deep therapy given by Dr. Ernst with a machine not nearly so effective as those of the present day, caused the most marvelous melting of this mass. The patient is living and well. I have seen another inoperable with resulting improvement of symptoms.
tumor of the kidney reduced in size

In cancer of the bladder, I have seen excellent palliative results, but when used alone, no ultimate benefit. Associated with resections and along with endovesical high frequency application I have used it routinely.

I am positive that an operable tumor should always be removed and furthermore the more experience the surgeon has had, the more often tumors are found operable. One should never, in my opinion, offer in such cases, either x-ray or radium as a substitute for surgery, but only as an adjunct.

In prostatic cancer with periprostatic involvement associated with severe pains in the hip and legs, almost invariably there has been, after the second application, almost complete cessation of pain. I have noticed the tumor mass soften materially and urinary obstructive symptoms decidedly quiesce, but these results have unfortunately been evanescent. The condition has usually returned.

In the early lesions, well localized clinically, the x-ray or radium or both should be given a trial and the patient's condition carefully observed.

In prostatic cancer, there are two chief problems, the first the cure of the cancer and the second the handling of the often associated urinary obstructions. If the process is limited and obstruction is minor, the x-ray or radium or both may be all that is necessary. If the tumor is larger and responds to deep therapy, the obstruction may often be relieved, by the cautery punch operation.

In gross obstructions surgical removal is required and my best results in prostatic cancer have been the ones in which perineal prostatectomy had been done with implantation of radium into the capsule, followed by deep x-ray therapy.

I am extremely interested in this type of therapy and am very fortunate to be associated with Dr. Sherwood Moore and Dr. Ernst who has advised or conducted most of these treatments.

In conclusion it is fitting that I pay a tribute to roentgenology as the inseparable handmaiden of urological diagnosis and therapy. The human eye, though aided by the most ingenious devices of a mastercraft must still be limited in its range of vision, but the x-ray, like something divine, has power in a search for disease and its symptoms to penetrate the innermost recesses of our earthly structures, to lay all secrets bare and leave little to be disclosed for scientific investigation.

723 University Club Bldg.

X-Rays and X-Ray Apparatus; An Elementary Course*

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Chapter II.—(Continued)

The Mercury Break Interrupter

36. For small coils, or those on which heavy demands are not to be made, the hammer break is fairly satisfactory. With coils which are to be used for heavy radiographic work, the hammer break is of little use. The excessive sparking, accompanied by disintegration of the contact points, makes such a break very unsatisfactory. Large coils, therefore, are operated by using either a mercury or an electrolytic interrupter. The principle utilized in the construction of the former of these will be clear from the following brief description of one type in common use. By means of a motor (Fig. 35, a, top view; b, side view) a vessel V whose lower portion dips in mercury can be rapidly rotated. As a result of the rotation mercury rises until it is forced out of the tubes J_1 and J_2 at the top of the vessel. If the tubes are in the position shown in Figure 35b, the jets of mercury on leaving the tubes strike two metal pieces A and B which take the place of the contact points of the hammer break. In other words, the interrupter is placed directly in the primary circuit and current can only flow when there is electrical connection between A and B. This will be the case when the jets are anywhere between positions I and II of Figure 35b. As soon, however, as the vessel has rotated past position I, contact is broken. As V rotates, therefore, the current is regularly interrupted, the number of interruptions depending on the speed at which the motor is rotated. The rotating vessel, together with the contact pieces A and B and the supply of mercury are all enclosed in a containing vessel in which the air is replaced either by a liquid dielectric such as paraffin or by ordinary illuminating gas from the supply mains. In the latter case care must be exercised that no air is left in the apparatus, otherwise an explosion may occur.

From the nature of this break, it should be clear that the frequency (the number of makes and breaks per second) may be varied over a wide range by simply regulating the speed of the motor. Frequencies as high as 200 per second may be obtained. By way of comparison it may be stated that although in the case of the hammer break, the frequency may also reach this maximum value, it is often as low as 25 or 30 per second.

The Wehnelt Electrolytic Interrupter

37. To utilize this type of interrupter, a vessel containing a 20 per cent solution of dilute H_2SO_4 (specific gravity 1.2) is inserted in the primary circuit. The positive electrode (the anode) is a platinum point P (Fig. 36), the negative electrode (the cathode), a large lead plate L. (Note also Fig. 37.) With such a device, when the primary circuit is closed in the usual way, the current is regularly and rapidly interrupted at the platinum point, provided current conditions are within certain limits. The amperage, for example, should not be much below 10 nor much above 40 amperes, while with voltages across the terminals exceeding 80 to 120 the interrupter will not work. Potential differences of the order of 60 volts are normal.

*—Received for publication February 9, 1923.

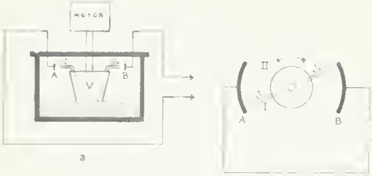

FIG 35

FIG 36

It is difficult to state with certainty the exact nature of the action of this type of interrupter. It is somewhat as follows: When the current begins to flow, the formation of gas bubbles about the platinum point introduces an insulating layer which soon breaks the circuit; the E.M.F. of inductance causes a spark to jump the gap, thus exploding the gases and closing the circuit once more. In some such way a periodic opening and closing of the circuit takes place. But the action is complicated, the frequency depending on the amount of inductance and of capacity in the circuit, the temperature and the concentration of the acid, and the size of the platinum point. By means of an insulating sheath S, the extent to which the platinum point is exposed to the acid can be altered and in this way the interrupter regulated. Values of the frequency as high as 1500 or 2000 per second may be obtained, while even with heavy currents the frequency may not go below 200 per second. "With a suitable current the anode is normally surrounded by a violet light, and the interruptions are of an explosive and almost deafening character" (Kaye). Silencers, however, are now added, thus eliminating to some extent the latter undesirable feature.

The electrolytic interrupter has the advantage that no condenser is necessary, but the disadvantage that considerable inverse is present.

Suppression of Inverse or Reverse Current

38. As already noted it is highly undesirable to have any reverse current passing through an x-ray bulb. The reasons for this will be more apparent later; here we may simply state that inverse current (1) gives rise to x rays from parts of a tube other than the target; (2) increases the possibility of a tube puncture and, apart from puncture, shortens its useful life; (3) gives rise to erroneous and consequently misleading readings of the milliamperage in the tube circuit (Regarding (3) it should be evident, that, since milliamperemeters are *direct* current instruments, the presence of a reverse current will make the reading on the instrument less than that corresponding to the current passing in the right direction.) When, therefore, coils are used as the source of high potential, certain rectifying means are used to suppress any inverse which may be present. A brief reference will be made to a few of these:

(1) *The Spark Gap.*—Any kind of spark gap inserted in series with the x-ray tube, as in Figure 38, is effective, provided the voltage necessary to cause a spark to jump the gap has about the same magnitude as the inverse. Obviously a voltage less than that corresponding to the spark length can cause no current in the tube circuit. This method entails a considerable loss of energy, and would be useless for cases where the magnitude of the inverse voltage approached that of the direct.

(2) *The Point-Plane Gap.*—An improvement of method (1) consists in using a point-plane spark gap. This is more effective because a discharge crosses such a gap more readily when the point is positive than when it is negative. Such a gap, therefore, should be connected in series, just as in Figure 38, care being taken that, for the current in the right direction, the point is joined to the negative terminal (the cathode) of the tube.

(3) *Valve Tubes—Old Type.*—Perhaps the rectifier most frequently

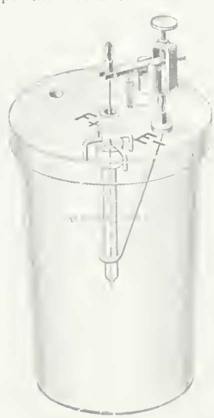

Fig. 37

used with coils is the valve tube. The older type consists essentially of a vessel (Fig. 39) from which the air has been *partially* removed, and which contains two electrodes, one, A, enclosed in a side arm, the other, B, extending into the central part of the valve tube so that, unlike the first, it is quite *unrestricted.* The efficiency of this kind of valve depends on the fact that, with the gas pressure in the vessel within proper limits, a restricted electrode will function practically only as an anode (i. e. a positive terminal). Such a valve, therefore, is placed in series with the x-ray bulb, again, just as in Figure 38, care being exercised that the restricted electrode is joined to the negative terminal of the tube.

(4) *Valve Tube—New Type. The Kenotron.*—A much more satisfactory type is found in the *Kenotron*, a detailed description of which will be given in connection with the Coolidge tube. Here we may note that the principle utilized is exactly the same as that underlying the valves used so extensively in "radio" work.

(5) Other mechanical rectifiers have been used in connection with induction coils, at least one of which differs little in principle from the rectifier utilized in the interrupterless transformer. Little would be gained, however, by extending our discussion on this subject.

The Coil Versus the Transformer

39. Although the coil for heavy x-ray work is used so little in the United States and Canada that one can with difficulty find it mentioned in advertising literature, it should not be overlooked that in England the coil is by no means obsolete. In the recently (November, 1922) opened x-ray department of the Manchester Royal Infirmary, for example, coils have been retained in the treatment room, although high tension transformers form the major portion of this part of the equipment. Moreover, in the extensive volume on radiography by Knox (Vol. I, 1917), radiographs are shown which indicate, if anything, superior work in the case of the coil. Further evidence that much is to be said for the coil is found in the report in the *Electrician* (March, 1920) of a discussion on this whole question by eminent English radiologists, in conjunction with electrical engineers. It must be remembered that the coil generates a high voltage which attains to its maximum value and drops to zero in a small fraction of the time between successive breaks, whereas in the case of the transformer, the high voltage is applied for often a considerable fraction of a half cycle, that is, for a considerable fraction of the total time between successive impulses. This gives the coil an advantage within the

limits of its capacity. But, for heavy work, the advantages are all in favour of the transformer, while the freedom from interrupter troubles is a tremendous gain.

Chapter III.

The Origin of X-Rays

40. In the gas bulb a current passes through the rarefied gas in the bulb; in the Coolidge tube, a current passes, although the vacuum is as perfect as modern means of exhaustion can make it. Before the action of either can be understood, it is necessary to consider somewhat in detail the whole question of the passage of electricity through a gas. At the outset, it is well to recall certain fundamental electrical ideas.

Any two bodies when rubbed together (so that their surfaces may come into close contact) become electrified, one positively, the other negatively. By positive, we mean simply a charge of electricity similar to that on a glass rod which has been rubbed on silk; by negative, a charge similar to that on an ebonite rod rubbed on fur, or to that on a piece of sealing wax rubbed on wool.

A body with a positive charge repels a second body similarly charged, but attracts a negatively charged one.

To study many things in connection with electrified bodies, one frequently uses the *gold leaf electroscope*. In a simple but useful form, this consists of a metal rod AB (Figure 40) *insulated* from the supporting vessel, attached to which is a piece of light metallic leaf CD (*gold* leaf is not necessary). If the rod and leaf are given an electric charge, either positive or negative, the leaf is deflected an amount proportional to the charge on the insulated system.

Ionization of a Gas

41. Suppose an electroscope, made with the most perfect insulation possible, is given a charge. If the deflection of the leaf is observed hour after hour, it will be found that, although there is an extremely slight falling of the leaf, the charge is retained even for days. We conclude, therefore, that while air is not a *perfect* insulator, at any rate it is an extremely poor conductor of electricity. (Evidence that air is not a perfect insulator has been given implicitly when it was pointed out that, once the voltage across two conductors exceeds a certain value, a spark jumps the gap between them.)

It is possible, however, to put air into a fairly good conducting state. A simple experiment will illustrate one means of doing so. Suppose a lighted match is held near the projecting end of a charged electroscope. It will be found that in a few seconds the leaf has fallen and the electroscope is discharged. The air in the neighborhood

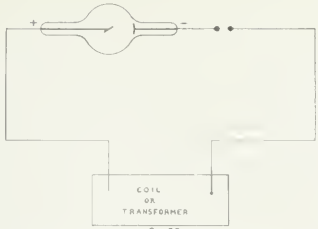

FIG. 38

of the electroscope has had its conductivity enormously increased by the presence of the flame. In other words, the flame is what we call an *ionizing agent*, causing marked ionization of the air in its neighborhood. An explanation of the meaning of ionization can best be given with reference to one or two further experiments.

Suppose we have an arrangement of apparatus similar to that illustrated in Figure 41. In this case air from the neighborhood of a flame may be sucked through a tube LM, into which projects the top K of the insulated rod of a charged electroscope. With such an arrangement it will be found that as soon as the air from the flame is sucked along the pipe, the electroscope begins to lose its charge. Evidently air in the conducting state can be carried from place to place.

Imagine next, that the apparatus is altered so that the ionized air in its passage along the tube has to pass between two plates P_1 and P_2 (Figure 42), which are joined one to the positive, the other to the negative terminal of an electrical machine or high voltage battery. It will now be found that, in spite of the suction through the tube, the electroscope *retains* its charge. In other words the conducting air, after passing between the charged plates, has lost its conductivity or is no longer ionized.

The removal of the conductivity by the charged plates (and many other experiments) suggests that air is made a conductor because of the formation by the flame of small electrified particles or *ions*. This provides a ready explanation of the discharge of the electroscope. If it is positively charged, and ions are formed near it, positive ions will be repelled, negative attracted. Each negative ion, on reaching the insulated rod of the electroscope, will annul some of the positive charge on it until finally the electroscope is completely discharged. Moreover, all the time the discharge is taking place, *there is a stream of positive ions in one direction, negative in the opposite.* Such a stream of ions constitutes an electric current through the air.

Ions and Electrons

42. But, it is asked, what *are* ions? As a result of the work of the physicist in the last twenty or thirty years, the answer may be given with some confidence. It is now believed that an atom (of an element) consists of a core or nucleus, positively charged, together with a certain number of small negatively charged particles, called *electrons.* In spite of the attraction of positive for negative, the electrons do not "fall into" the nucleus, probably because of their planetary motion about it. (The earth for the same reason, does not fall into the sun.) The nucleus, which is responsible for practically the whole mass of the atom, has a different constitution for each atom; electrons, however, whose mass is about 1/1800 of that of a hydrogen atom are identical in all atoms (See Section 46 below). The *number* of electrons, however, increases with the atomic weight of an element. For example, there is much evidence to indicate that the hydrogen atom has only 1 electron, helium 2, lithium 3, and so on until we reach heavier elements such as mercury with 80 electrons. (It is now generally accepted that the number of electrons in an atom is equal to the number of the element, when the elements are arranged in the order of increasing atomic weight, the so-called *atomic number.*)

Normally, the negative charge on the

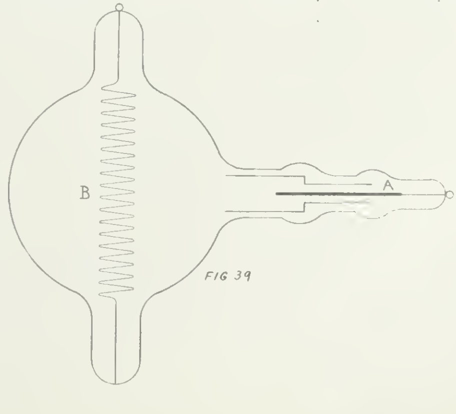

FIG 39

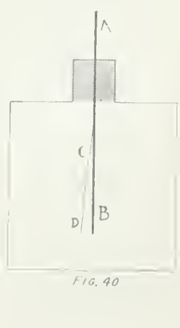

FIG. 40

electrons exactly neutralizes the positive charge on the nucleus, so that the atom in its ordinary state is electrically neutral. If, however, *by means of an ionizing agent such as a flame, an electron is removed from the parent atom, it should be evident that what is left will be a particle of atomic size, with an excess of positive electricity, or a positive ion.* The electron which has been removed may either remain "free" or attract to itself one or more neutral molecules, or atoms, thus forming what is called a negative ion.

Later we shall see that one of the most important properties of x-rays is their ability to ionize a gas.

(It should now be evident that, to account for the extremely slight conductivity of ordinary air we must assume the existence in air at all times, of a few stray ions.)

Conductivity of Air at Pressures Less than Atmospheric

43. In this course, we are interested particularly in the conductivity of air at pressures considerably less than atmospheric. Suppose that the terminals of an x-ray bulb or any "vacuum" tube with electrodes A and B (Figure 43) are joined to an induction coil or a high tension transformer. Suppose, further, that the tube at the start contains atmospheric air, and that the electrodes are at such a distance apart that no spark discharge can take place. If now, by means of an exhaust pump, the air is gradually removed from the tube, a stage will soon be reached at which a discharge passes readily—this stage being indicated by a line of luminosity which extends from one electrode to the other. As exhaustion proceeds the current passes more and more readily until a second stage is reached beyond which the current passes less readily until finally, when a very high vacuum has been attained, the resistance is so great that the tube will not conduct at all. Some actual measurements (taken from Townsend's *Electricity in Gases*) are given in Table III. This table gives the voltages necessary to maintain a current of 10 ma. through a tube 3 cm. in diameter, with electrodes 11.5 cm. apart, at various pressures.[1] It will easily be seen that as the pressure lowers, at first a lower and lower voltage is required, but after a certain critical value has been reached, higher and higher voltages are necessary. Evidently, then, *the resistance of a vacuum tube or a gas x-ray bulb depends on the degree to which it has been exhausted.* Moreover, after a certain critical pressure has been passed, it is more and more difficult to pass a given current through an exhausted tube. Technically, it is said that the tube becomes *harder and harder*, as the pressure gets lower and lower. The harder a gas x-ray tube is, therefore, the greater the voltage necessary to maintain a given current through it.

TABLE III.

Pressure	4 mm.	2.84	1.65	1.04	.66	.4	.29	.24	.17
Voltage	650 volts	620	500	470	490	530	590	630	740

The Appearance of a Vacuum Tube Carrying a Current

44. The appearance of a vacuum tube when conducting a current at low pressures is very beautiful, and has certain general characteristics which it is well to note. Initially, or very shortly after the gas has become conducting, a single sharp narrow streamer extends the length of the tube. As the pressure is reduced, the band of light becomes wider and more and more diffuse until the whole tube is filled with luminosity. At still lower pressures (of the order of half a millimeter), the tube has a striking and very characteristic appearance: (1) around the cathode is a thin luminous layer, A in Fig. 44; (2) next is a *sharply* defined dark space B, followed by, (3), another luminous region C, then (4), a second ill-defined dark region D, and finally (5), a column of luminosity E, extending to the anode. At certain pressures this column is broken up into beautiful striations, that is, narrow regions alternately dark and light.

Most important of these regions is the sharply defined dark space, the Crookes' dark space, as it is called, or sometimes "the" dark space. With decreasing pressure, its width continues to increase, and is indeed a rough measure of the degree to which the tube has been exhausted. In the case of a gas x-ray tube, the dark space should fill the whole tube. If by any chance any x ray bulb presents the above appearance, that is, one with marked luminosity, the pressure is much too high and the tube must be re-exhausted before it is of any use. In the case of a Coolidge tube, careless manipulation may result in the liberation of gas. If sufficient gas is present, this will be evident by the general luminosity filling the tube when a high voltage is applied. Again, re-exhaustion is the only remedy.

Cathode Rays

45. When exhaustion is extended beyond that giving rise to the above characteristic appearance, the dark space, as already noted, grows wider and wider until it finally fills practically the whole tube. This occurs at what we may call the x-ray vacuum, for the pressure has now been reduced[2] to about 1/100 mm., that it, to a value which is about the order of that in a gas x-ray bulb.

At this pressure a very faint beam of light proceeding *at right angles* to the cathode is frequently visible. Depending on conditions, this beam may be narrow, covering only a small portion of the face of the cathode, or it may cover nearly the whole of it; it may be extremely faint, or it may be well defined. (Often it is quite visible in a "soft" x-ray bulb). The direction of this beam, moreover, is independent of the position of the anode. For example, in a tube of the shape illustrated in Figure 45, the beam is still at right angles to the cathode, although the anode is in an arm at one side of the tube.

A second important appearance is characteristic of this stage. The walls of the tube, particularly at the end opposite the cathode, are seen to fluoresce with a light, frequently greenish, but whose colour depends on the composition of the glass. That the fluorescent light has some connection with the faint streamers, is readily shown by simply bringing one pole of a magnet near the cathode end of the tube. Both the faint beam of light and the position of the fluorescent light at the other end move simultaneously.

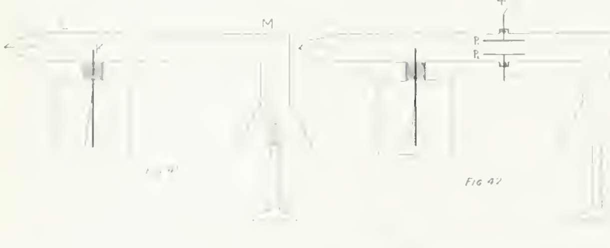

Fig 42

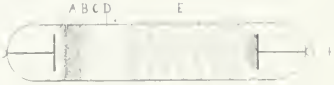

Fig 44

The name *cathode rays* has been given to the faint beam of light. What is their nature? Before answering this question it is desirable to look at some properties of the rays: (1) From what has just been stated, cathode rays are deflected from their path by a magnetic field, and (2) excite fluorescence where they strike the walls of a glass tube. (3) They travel in straight lines. This is readily shown by using a tube of the kind illustrated in Figure 46. With such a tube it is observed that if an obstacle P is placed in the path of the rays, a *sharp* shadow is cast on the end of the tube, all the region around the shadow strongly fluorescing. This could be caused only by a beam which, like light rays, travels in straight lines. (4) Cathode rays represent a considerable amount of kinetic energy. This may be shown by using, not a plane cathode, as represented in Figure 45, but a concave one. By this means the beam of rays (which it was pointed out above proceed normally from the cathode) can be brought to a focus at a point, as illustrated in Figure 47. If, now, a thin piece of metal be placed in a tube so that the spot to which the rays are focused is on the surface of the metal, in a short time incandescence will be observed in the neighborhood of the spot. On impact of the rays against the metal a large amount of heat is developed. (This point is of very great importance in connection with the action of either the gas or the Coolidge tube).

(5) Cathode rays are deflected from their path by an *electric* as well as by a magnetic field. To show this a tube constructed as represented in Figure 48 is used. Two pieces of metal A and B with small axial holes are inserted in the tube near the cathode, so that a narrow pencil of cathode rays may be obtained. This beam may be visible for only a short distance from the cathode, if indeed it can be seen at all, but, if at the far end of the tube, a fluorescent screen S be placed, the presence of the rays is at once evident by a round fluorescent spot at O on the screen. Suppose, now, the tube has been constructed with two metal plates P_1 and P_2, and that these are joined, one to the positive, the other to the negative terminal of a battery. It will then be found that the spot of light shifts from O to K. *In their passage through the electric field between the plates, the rays have been deflected.*

From this and the other properties enumerated, we conclude that cathode rays consist of *a stream of electrified particles.* Moreover, from the direction of the deflection by the electric field, the charge they carry is at once seen to be *negative.*

46. How big are these particles? How fast do they move? The answers to these questions are found in quantitative experiments made with tubes of the nature of that shown in Figure 48. Without going into details, it should be evident that the amount of the deflection OK will depend both on the *speed* of the rays and on their *mass*, as well as on the strength of the deflecting electric field. The faster they travel, and the bigger their mass, the less will be the deflection in any given field. By measuring deflections, therefore, for electric (and magnetic) fields of known strength, it is possible to obtain values of the mass and of the speed of cathode rays. Such measurements show that the mass of each particle in a beam of cathode rays is about 1/1800 of that of a hydrogen atom. The speed varies with the voltage applied across the tube, but may be of the order of 60,000 miles a second.

Another remarkable fact is evident from such experiments. No matter what gas is used in the vacuum tube, and no matter what the metal used for cathode, the mass of a cathode "ray" is always the same. The general conclusion is obvious: *Cathode rays are just electrons which have been liberated from the atoms of elements and shot down the tube from the region of the cathode. They are high speed electrons.*

Origin of X-rays

47. When cathode rays strike a metal surface (a target) placed in their path, a new kind of radiation originates at the place of stoppage. These new rays, which possess the remarkable property of being able to penetrate thick layers of apparently opaque substances, are called roentgen or x-rays. The first name is in honour of their discoverer, Roentgen; the second indicates the uncertainty regarding their nature which obtained for some years after their discovery. Later we shall discuss their nature and general properties; at present we are concerned with the mode of obtaining x-rays. This can be done only by having high speed electrified particles (electrons) suddenly stopped.

To obtain a supply of such electrons, two totally different means are utilized. In the first method (the gas x-ray tube) enough gas is left in the exhausted tube so that when a high voltage is applied to the electrodes, a current is conducted across the tube by means of a flow of ions, positive towards the cathode, negative to the anode. Now, it has been shown experimentally that between the cathode and a region very close to it there is a big drop in voltage. Accordingly, when the positive ions get near the cathode they are shot (or pulled, if you like) at high speed against it. As a result electrons are liberated either from the gas immediately before the cathode or from the metal of the cathode itself (it cannot be said with absolute certainty which is correct). These liberated electrons in their turn are shot, as a beam of cathode rays, away from the cathode, and when suddenly stopped give rise to x-rays.

In the second method, as exemplified by the Coolidge and the Lilienfeld tubes, there is not enough gas left in the tube to conduct a current, even with extremely high voltages, and electrons are obtained in an entirely different manner. Before beginning a discussion of the new principles underlying the use of these tubes, however, it is desirable to examine in detail the construction and the operation of the gas bulb.

Footnotes

1. Readers will recall that the pressure of a gas is frequently expressed in terms of the length of the column of mercury it will support. Atmospheric air, for example, will support a column of mercury which varies from day to day, but is in the neighborhood of 760 mm. In the experiment to which Table III has reference, an air pressure has been reached which supports only a column of 17/100 mm. of mercury.

2. We speak of raising the vacuum when we lower the pressure.

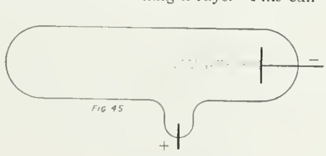

FIG 45

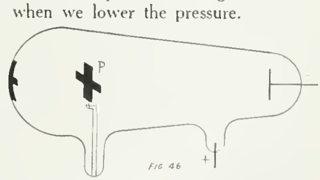

FIG 46

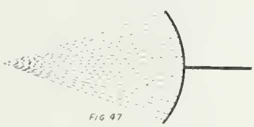
FIG 47

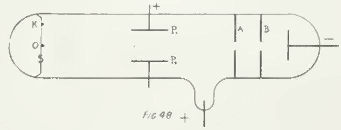

FIG 48

The Auto-Electronic X-Ray Tube of Lilienfeld*

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THERE are two types of tubes in general use. These types differ mainly in the method by which the electrons essential for the bombardment of the target are produced. They are: (a) the hot cathode tubes (thermo-electronic), and (b) the gas tubes (ionic).

The Hot Cathode Tubes (Thermo-Electronic)

In the hot cathode type of tubes represented by the Coolidge hot cathode tube in this country and the Lilienfeld hot cathode tube in Germany, the electrons are produced from a cathode of a wire of suitable material (tungsten, tantalum) through heating by an electric current. The vacuum of the tube is very high, at least twenty times that of an ordinary gas tube, and no discharge can pass unless the cathode is heated.

The Gas Tubes (Ionic)

The exhaustion of the gas tube, on the other hand, is never so high, traces of gas being left in the tube. In this type of tube ions in the residual gas are the source of the electrons. When the tube is energized the electric field disintegrates the electrified atoms into positive and negative ions. Some of the negative ions become embedded in the glass walls of the tube and this is responsible for the gradual hardening of the gas tube. The positive ions are driven against the cathode, the bombardment of which results in the release of electrons. In their rush to the anode these electrons ionize the atoms of residual gas, thus further producing more positive ions and electrons. The electrons produce the x-rays by impact against the target.

In the hot cathode tube it is possible to vary the voltage independently of the current, for the current is limited by the number of electrons emitted from the cathode and this is controlled by the heat produced in the cathode filament. In the gas tube, on the other hand, the current increases with the voltage.

Kaye has pointed out that since the hot cathode tube utilizes its "saturation" current its spectrum is much less affected by changes in the wave form of the exciting potential than the gas tube, in which the absence of saturation permits a more effective use of very high voltages with a greater output of radiation from the input of the same quantity of energy.

* Received for publication June 4, 1922.

To these two types, Lilienfeld has now added a third type of tube, the autoelectronic tube.

The Autoelectronic Tube

The vacuum of this tube is very high, the exhaustion being considerably greater than that of the hot cathode type of tube. It is nevertheless possible to directly energize this tube, by virtue of a special construction and arrangement of the cathode and anode by which electrons are liberated from a cold cathodal surface.

Lilienfeld claims that in this new type of tube the electrons are released by a phenomenon which he is the first to have observed, one in which ionization plays no part whatever. That is to say, there is neither the ionization of the residual gas nor the ionization through a hot spark discharge between the anodal and cathodal surfaces. It is primarily the intense electrostatic field (created by a certain construction) which pulls the electrons from the cold metallic cathode.

This tube differs, therefore, from the hot cathode tubes in that the cathode is and remains unheated and from the gas tube in that there is no ionization of the residual gas. The striking difference in construction between this tube and the gas or Coolidge tube lies in the form of the cathode, which is a sharp point, and in the relationship as regards position of the anode and cathode, which are comparatively close together (about 6 mm.).

The Tube

The tube is a spherical bulb about thirteen centimeters in diameter, having three or four extensions, depending upon the number of cathodes. The anodal extension has the characteristics usually found in anodes with water-cooling devices. The cathodal extension is narrower and supports the cathode. Where there are two cathodes the glass extensions make a slight angle with each other, the terminals being separated for a distance of ten centimeters. Opposite the cathodal extension is a chamber with a sputtering device for raising the vacuum. This plays no part at all in the activation of the complete tube.

The Cathode

The cathode is a wire with a pointed tip. This projects from a small collar at the neck into the bulb in a direction parallel to the axis of the tube for a distance of about six centimeters. At this point it is bent towards the anode at about an angle of one hundred and thirty-five degrees, the inclined portion being about two centimeters in length. The pointed end of the wire cathode approaches the anode or target to within a few millimeters, projecting into a depression on the anodal surface. It is this depression which acts as the focal spot. The tube may have one or more cathodal points. These points may project into the same anodal depression or into individual anodal depressions. The pointed ends of the cathode vary in sharpness. Until now three varieties of cathodes have been produced, the sharp point, which is called the "S" or "soft" point; the blunt point, which is called the "H" or "hard" point; and a point of medium sharpness, which is called the "M" or "medium" point. These have their applicability for the production of radiations of different penetration as will be indicated later on.

The Anode

The anode consists of a copper head into which is inserted a tungsten button. The true anodal surface—the target—is entirely of tungsten. The copper head shows a smooth depression along the surface directed towards the cathode. At the very edge of this tungsten button below the depression in the copper carrying stem are one or more small pits or depressions. This grooves both front and side of the tungsten button equally. It is these depressions in the anode which act as the focal spots and into which the cathodal points project between the anode and cathode. Owing to the short distance and the depression in the anode, the secondary electrons cannot leave the focal area, consequently the number of electrons making impact against the stem is greatly reduced as compared to the Coolidge tube. This, of course, conspicuously diminishes the extent of stem radiations and makes for better definition and contrast.

Connections and Operation

The tube is connected in the usual way, just as a gas tube is connected. The anode water-cooling device is connected to the positive wire and one of the cathodes to the negative wire. There is only one accessory device to the ordinary installation use for the gas tube. This is a resistance, consisting of carbon coating on the inside of the glass tubes. These are connected, one at each terminal in series with the tube. These resistances are not essential, but are valuable in that they dampen the high frequency oscillations of the transformer.

When energized the tube has a feeble irregular fluorescence in several parts. The fluorescence of the glass in the frontal part, which is visible only in the dark, is due to the impact of the

x-rays against the wall. There is also some slight fluoresence about the neck of the anodal extension. The shadow of the anodal stem is visible on the back part of the bulb and the shadow of the cathodal point is visible on the frontal part of the bulb. At low load, the depression glows with a bluish haze. Increasing the load produces a brilliant white glow in the depth of the depression without disintegration. There is apparently no movement of the focal point with heavy loads. Even should movement occur, it can only take place within the anodal depression and there would not be any blurring of the radiograph, because the entire depression really acts as the focal point.

There is no heating of the cathode by the discharge current, no cathodic disintegration nor could any change in the conformation of the cathodal point be detected after usage. There is a gradual but slight tinting of the glass with usage. There is no metallic deposit on the glass.

The tube acts as a valve and does not at any time allow the current to pass in the inverse direction.

No milliamperage is appreciable until a certain voltage—critical voltage—is attained. The value of this critical voltage depends on the characteristics of anode and cathode, in other words, upon the shape and size of the cathodal point, size of the anodal depression and the geometric relationship of anode to cathode. This has an important bearing on the use of this variety of tube for therapy. For the relationship of the parts may be so made that this critical voltage be as high as 60,000 or 70,000 volts. Thus the generation of those softer radiations by the lower voltage may be entirely eliminated.

As the voltage is increased a definite current value is obtained for each voltage, the current gradually increasing, as the voltage is raised. In this respect the tube resembles the gas tube, but the definite current value for each voltage is constant for the particular tube at all times, in which respect it is far superior to the gas tube. The sharper the point of the cathode the more rapid the increase of current and the greater the current value for the same voltage. Coincident with the increase in the voltage there is an increase in penetration with increasing current up to a certain point. Beyond this slightly increasing the voltage produces a great increase of the current, so that roughly speaking there is no appreciable increase in penetration with increasing current.

Testing one of the tubes the value of the discharge current for each voltage was tabulated, first with the "S" point and then with the "H" point.

"S" Point		"H" Point	
Spark	Ma.	Spark	Ma.
(3)	1.8	(4¼)	½
(4)	4½	(4¾)	2
(4½)	8	(5¼)	3.2
(4¾)	9½	(5½)	4
(5¼)	13½	(5¾)	6.4
(5½)	15½	(6½)	10
(5¾)	23		

It is noticeable that for the same voltage there is a smaller milliamperage with the hard point than with the soft. The values indicated on the curves are not interchangeable. In other words, a certain milliamperage at a given voltage on the "S" point cannot be utilized for the same purpose on the "H" point. The resulting radiographs have different characteristics. This is due to the amount of the current wave which is utilized by the particular point. More of the curve is utilized by the "S" point than by the "H" point, which simply utilizes the peaks. It is for this reason also that primary voltage readings are not an accurate indication of the impressed voltage across the tube terminals because the characteristic of the tube distorts the form of the wave. Measurement by spark gap shows that with the same primary voltage, the spark gap value is somewhat less with this tube than with the hot cathode, under identical conditions. The penetration for either point "S" or "H" increases at first definitely with the increased primary voltage and then practically not at all the only result being increased current without any conspicuous increase in penetration. Any degree of penetration can, therefore, be obtained by selecting the proper point and the proper load and this is constant for the thickness of tissue and with the same recording surface and distance there is an exact time value at which a proper record of densities is obtained. So that the final exposure table with these new tubes will give tissue thickness in inches (point), load and time as the important factors.

Exposure Table

The "S" or soft point, is to be utilized for the radiography for the less dense portions of the body, as the extremities, the head in the lateral position, the urinary tract, the chest. The "H" or hard point is to be utilized for the radiography of the hip (for bone disease), the head in the saggital position, the gastro-intestinal tract.

FIG. 1

Fig. 1—Lilienfeld tube, side view.

FIG. 2

Fig. 2—Anode head showing two depressions which have focal heads.

FIG. 3

Fig. 3—Cathodes sharp and blunt point.

Duplitized Films—Normal Developer—"S" Point

58000 volts (auto-transformer)
12 milliamperes, Focal Distance 24-in.

Phalanges	1/6	Wrist	1/4
Tarsus, Ap	5/24	Forearm	1/2
Lat.	1/4	Elbow	1/2
Ankle . . Ap.	1/2	Arm	3/4
Lat.	2/3	Shoulder	1
Knee . . . Ap.	3/4	Cervical spine,	7/8
Lat.	1	Head lateral	2
Thigh	1 1/4	Mastoids	2
Fingers	1/6		

Urinary tract 4 1/2, 55,000 volts, 9 1/2 milliamperes.

Chest 3/8, 83,000 volts, 35 milliamperes, Focal distance 28 inches.

"H" Point

Head 5, 90,000 volts, 7 1/2 ma.
Hip 3, 80,000 volts, 6 1/2 ma.
G. I. Tract, 1/20 screen.

1/4 sec., no screen, 80,000 volts, 25 (?) milliamperes, focal distance 28 inches.

Characteristics of the Radiograph

The definition is fine, the plates show the absence of blurring or fogging, the contrast is good with distinct gradations and the high lights or areas of maximum density are of a dense jet black color. The improved quality of the radiograph is due not so much to the great intensity and the relatively small focal point as to the absence of the stem radiations.

The chest plate shows fine contrast with a wealth of sharply outlined detail.

The gastro-intestinal examination can be made without screens. As compared to screen negatives the former lack contrast, but there is more sharpness and definition. It would seem, judging from the radiographic effects, that this tube gives at least four times the x-ray output of a Coolidge tube and twice the output of a medium vacuum gas tube.

The experience with the tube is naturally still limited and usage and experience may compel a modification of the present feeling that this new tube, with its high intensity of radiation permits a great stride in the proper direction—in the direction of simplicity of technique, shortness of exposure time and fine radiographic definition.

Fluoroscopy

For this purpose the connections are as above described. The only maneuver is the necessity of keeping the water-cooling device filled with water. The tube works steadily, giving excellent definition and fine contrast with three milliamperes and 60,000 volts.

Comparison of the Various Types of X-Ray Tubes

Characteristics	*Gas*	*Thermoelectronic*	*Autoelectronic*
Stability	Unstable — continuous regenerating required	Stable — If the heating current is controlled	Continuously stabile
Variables to be observed	3: Voltage Milliamperage Gas pressure	3: Voltage Milliamperage Amperage of heating apparatus	1: Either voltage or milliamperage
Photoactive radiation from focus for a given voltage and mills per unit	2	1	6-8
Photoactive radiation outside the focal point.	Front part of glass bulb	Stem radiation	Negligible
Definition of radiographic, fluoroscopic image	Good	Fair	Good
Homogeneity	Medium	Minimum	Maximum
Average hardness at given voltage	Medium	Low	High

Comment

The advent of the hot cathode tube marked an epoch in the development of roentgenological technique. In contrast to the gas tube, the hot cathode tube was an instrument of precision and stability, an instrument capable of fairly accurate adjustment and by which a duplication of results was possible. With the advent of the hot cathode tube the worker was now enabled to measure the factors concerned in the making of the examination.

Devoid of the vagaries of the gas tube, by virtue of its very high vacuum, the ease of adjustment and control gives the hot cathode tube a tremendous advantage over the old form of roentgen tube, which it rapidly superseded in this country. On the other hand, almost from the beginning there have been difficulties with this type of tube. These difficulties arose from three sources: firstly, from the maintenance of the constancy of the cathode filament current value; secondly from the relatively broad focal spot of the tube and from the superabundance of radiation from other regions than those of the focal point of the anode; and thirdly from the smaller output of radiation from the Coolidge than from the gas tube under the same working conditions.

1. The accessory installation imposed by the filament circuit added a new responsibility to the technical equipment and brought with it all the difficulties associated with the care of a low tension circuit. It was soon found that accurate adjustment was not easily maintained, since marked variations in tube current followed the slightest changes in filament heat. The storage battery as a source of supply was rapidly abandoned for the more stabile step-down transformer.

That the important problem of stability and accuracy of adjustment is, however, not yet entirely solved, is proved by the recent appearance of stabilizers warranted to automatically control tube current fluctuations. It cannot be denied that the low tension circuit complicates rather than simplifies our technique.

2. It was not long before the examination of our radiographs disclosed to us the fact that we were dealing with relatively broad focus tubes, as compared to the gas tubes, even when we were utilizing the fine focus Coolidge tube and that comparatively clear radiographic definition could only be obtained with the very fine focus—the latest development, the radiator 30 milliampere tube. But here we were confronted with the difficulty of the limitation of the energy input incidental to the size of the focus itself, and because of the low milliamperage, necessitating a prolonged exposure and where a shortened time was necessary, we were driven to use the intensifying screen. And just now we are ploughing through a period where the tyranny of the screen holds complete sway. The intensifying screen is a nuisance and abomination in the x-ray laboratory. It is an accessory device which might be well dispensed with. It adds additional maneuvers and procedure to the already complicated procedure incidental to the

making of the radiograph. It entails additional duties and observances on all concerned in the laboratory. It is costly. In the early days of radiography the feeble output of the tubes demanded its use, even for making exposure of the softest parts of the body. But now when our apparatus permits us to produce a radiation of enormous intensity, it does seem anomalous that the intensifying screen is still so generally utilized.

The attempt to obtain better radiographic definition with the broader focus hot cathode tubes, by increasing the target plate distance, only again drives us to the use of intensifying screens by the rapid increase of time, imposed by the inverse square law.

But more important as a cause of the lamentable lack of fluoroscopic and radiographic definition of the hot cathode tube are the indirect radiations, in other words, radiations from other sources than the the focal point of the target (notably the stem) with the consequent increase in secondary radiations from the object.

Close diaphragming and compression have not been sufficient by any means to eliminate this most important cause of poor radiography. Recently, however, the ingenuous Bucky diaphragm has been applied to this problem, but one must concede that the problem of technique has again not been simplified by this further addition of this accessory to our radiographic armamentarium.

For balanced against its "clean-up effect and the contrast and crispness which it helps to produce" is the necessity for increased penetration, increase in focal distance, marked increase in time, and, therefore, the use not only of single but double intensifying screens.

This is the present status of the radiographic technique, apparently daily growing more complex, with additional circuits, stabilizers, complicated diaphragms and double intensifying screens. The time is ripe for the advent of a new tube or a modification of the old that we may cease regretting our achievements with the gas tube. And if further experience with a definite type of this new x-ray tube bears out the results of the experiments with the models then indeed a great stride in the direction of simplicity of technique, shortness of exposure time and fine radiographic definition will have been made.

Summary

1. This, then, is a high vacuum tube, which may be called an auto-electronic tube, in contradistinction to the hot cathode (or better thermo-electronic tube), in which tube and electrodes are freed from gas to a point far beyond that obtained by any form of hot cathode tube.

2. This new high vacuum x-ray tube has an unheated cold cathode, the electrons being liberated at the cathode by the action of the electric field only.

3. The characteristics of the tube are invariable and fixed and dependent only on the geometrical arrangement of the electrodes.

4. The voltage and the magnitude of the current are under control, but not independently of each other.

5. In this new tube the milliamperage increases with the impressed voltage in a certain definite function.

6. There is a minimal variable critical voltage which is about 70 per cent of that utilized in active operation below which no discharge is apparent in the tube.

7. Under the same voltage and milliamperage the x-ray output of the new tube, as judged by comparative exposures has at least five times the intensity of the hot cathode tube.

8. The technique of the use of this tube is extremely simple.

9. The roentgen image (screen and plate) is characterized by definition and fine contrast, because of the minimal amount of radiation emitted from other points than the focal spot (stem radiations, radiations from the glass, etc).

10. The characteristics of the radiograph may permit the discarding of the accessory devices as screens, diaphragms, etc.

11. With the same voltage and milliamperage, the average hardness and homogeneity of the radiation is much higher than with the hot cathode tube. This is due to the form of the function characteristic of the discharge in the tube.

12. This considered with the high intensity and the high critical voltage, indicates the applicability of the tube to most exacting demands of modern deep therapy.

EDITORIAL

The JOURNAL OF RADIOLOGY

A Journal of Ideas and Ideals

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Science and History

HENDRIK von Loon recently made some remarks which are very pertinent at this time because of their reflection of the current thought about things scientific. In substance, he said that the historians had been responsible for all wars because of the manner in which they had recorded historical events, that they had placed undue emphasis on nationalism and too little emphasis on events of an international nature. To drive home his point he used two concrete illustrations. He is reported to have said that if one goes to the public library he will find many, many volumes recording the events which occurred during the reign of King Charles II, the stress being placed upon the acts of the king himself. After reading these volumes, one gathers the impression that all events of that period gather around King Charles until in a small footnote somewhere it is discovered that during the reign of King Charles II a young scientist, Isaac Newton, was lying on his back under an apple tree one day. While lying there, he saw an apple fall from the tree to the ground. From this simple commonplace occurrence, Isaac Newton deduced the Law of Gravitation and many other physical principles related thereto. According to Hendrik von Loon, if history were properly recorded, there would be many, many volumes telling about the discovery of the Law of Gravitation by Isaac Newton and in a footnote somewhere one would read that King Charles II was reigning when these momentous discoveries of nature's law were being made. The Law of Gravitation is international, affecting all beings wherever located without regard to political boundaries, while the deeds of King Charles II were of chief interest to a small group of individuals who happened at the time to live in his domain.

As a second concrete illustration of his meaning, Hendrik von Loon told of how if one goes to an American public library he will find books entitled, "Roosevelt the Roughrider," "Roosevelt at San Juan Hill," "Roosevelt the President," "Roosevelt the Man," "Roosevelt in Africa," "Roosevelt in South America," "Roosevelt the Writer," etc., and somewhere a brief mention of the fact that during President Roosevelt's administration two Ohio boys did something which had never before been done since the world began—they made man fly. Mr. von Loon is reported to have continued that Roosevelt was a great man. We needed him when we had him and we had him when we needed him. Had history been properly recorded there would be volume after volume telling of the international significance of the invention of the aeroplane by the Wright brothers and only brief mention of the doings of the great nationalist, the late President Theodore Roosevelt.

It would appear that the emphasis laid upon the international scope and influence of science by the historian, Mr. von Loon, is an index of popular thought at this time. Especially is this true when it is recalled that the remarks just recorded called forth loud applause from the large audience of the Omaha Society of Fine Arts to whom he was speaking.

Many others have called attention to the importance of science to humanity, using the pages of the popular magazines as their avenue of approach. That there is a popular demand for this kind of material is quite evident from the increasing number of articles now appearing in different magazines. The Saturday Evening Post is carrying a series of articles by Floyd W. Parsons, the second of which is entitled, "*Questions That Science Will Answer*," in which much stress is laid upon the importance of scientific achievement in the uplift of the human family. In the article appearing March 31, he, in substance, says that the most important branch of science is that which is connected with medical endeavor because thereby public health is conserved. All other lines of scientific endeavor are subordinate to those which contribute to the saving and prolonging of human life. That the importance of this kind of scientific effort is realized by those doing it is evidenced by the self sacrifice of many. Mention need scarcely be made of the hardships endured by Harvey, Pasteur and many others whose names are now immortal. The spirit of these men is beautifully described by Henry Drummond in *The Ascent of Man*, page 232, from which we quote:

> "To interpret the course of Evolution without this (law of sacrifice) would be to leave the richest side even of material nature without an explanation. Retrace the ground even thus hastily traveled over and see how full creation is of meaning, of anticipation, of good for man, how far back begins the undertone of Love. Remember that nearly all the beauty of the world is Love. Beauty—the corolla of the flower and the plume of the grass, the lamp of the firefly, the plumage of the bird, the horn of the stag, the face of a woman; that nearly all the music of the natural world is Love. Music—the song of the nightingale, the call of the mammal, the chorus of the insect, the serenade of the lover; that nearly all the foods of the world are Love. Foods—the date and the raisin, the banana and bread-fruit, the locust and the honey, the eggs, the grains, the seeds, the cereals and the legumes; that all the drinks of the world are Love. Drinks—the juice of the sprouting grain and the withered hop, the milk from the udder of the cow, the wine from the Love-cup of the vine. Remember that the Family, the crown of all higher life, is the creation of Love; that Cooperation, which means power, which means wealth, which means leisure, which therefore means art and culture, recreation and education, is the gift of Love. Remember not only these things, but

the diffusions of feelings which accompany them, the elevations, the ideals, the happiness, the goodness and the faith in more goodness and ask if it is not a world of Love in which we live."

Mr. Drummond is here laying stress upon the spiritual side of scientific advancement and correctly so, for after all this is the guiding star which leads the research worker on and sustains him until such a time as the rank and file recognize the value of his work.

The advances in science in recent years have linked the material and the spiritual more closely together. The marvels of the spoken voice, as revealed by the modern method of radio-transmission, inspire one with reverence for science and the great power back of it all.

The discovery of radioactive substances opened a complete new world to science, completely changing the arrangement of the elements and proving true to a certain extent, the old time theory of "transmutation of elements" which had previously been discarded. Professor J. Arthur Thompson in his *Outline of Science*, calls to our attention the value of radiant energy to mankind in the following words: "Energy is indispensable if the world is to continue to exist, since all phenomena, including life, depend upon it."

Radiant energy is the acme of all energy and with this powerful agent the radiologist is working continuously. The importance of this branch of medicine is becoming more clearly recognized day by day. Laymen nowadays who suffer some injury, request immediately that the physician employ the x-ray as a diagnostic aid in determining the extent of their injury. Such great value has this method of examination that the courts in several states have ruled that the physician who fails to take advantage of its help where at all possible, is guilty of neglect of the best interests of his patient. The therapeutic value of x-rays, radium rays, ultraviolet rays and many other portions of the spectrum, is becoming rapidly known by the layman as well as by the physician. It has frequently been the experience of physicians to have a patient suggest that he be treated by some of the forms of radiation just mentioned. This experience means that these physical agents will be employed by increasingly greater numbers of physicians as time goes by.

From an organizational standpoint, then, the field of the Radiological Society and the Journal of Radiology is unlimited. With every member's shoulder to the wheel pushing forward, there is no limit to possible accomplishment. The science of radiology can be made bigger and better by the cooperative effort of all men working in this field. The man who is serving the smaller community has no less responsibility than the man in the large city. The illustration cited by Dr. W. Warner Watkins in an able editorial in the February number of the Journal of Radiology hits the nail on the head. He tells how, in a certain community of approximately 10,000 inhabitants, one of the physicians in general practice took up radiology, secured the cooperation of all the other physicians, and, developing his powers as the demands upon them increased, built up a large practice in radiology. Radiologists who have had experience in general medicine before specializing, make better radiologists than these who have not had this experience. This is true because it gives them a broader viewpoint and a better knowledge of anatomy, physiology and pathology which are the foundation stones upon which all diagnosis is built. The Radiological Society, then, needs this type of man in its membership and by securing the cooperation of all interested in the specialty of radiology, greater good will come to all concerned.

The Sultan of Sulu and the X-Ray

HOW the use of the x-rays gained a diplomatic victory over the Sultan of Sulu some years ago is a fascinating story related for the first time.

When the United States acquired the Philippine Islands, the Sultan of Sulu, at first, kept his people as quiet as possible under the rule of the United States. One day, however, the military officer assigned to control, in telling the Sultan about the wonderful inventions of the Americans, described among other things the method of looking through the body with the x-rays. He told the Sultan that the bones of the hand could be seen with the x-rays just as plainly as though the flesh had been stripped off.

This was too much for the Sultan's credulity. He assumed a disagreeable attitude toward the military officer, whose influence began to wane. He told his people that the Americans were such great liars that no confidence could be placed in any of them and it was not long until he was demanding a greater pecuniary allowance in return for keeping his people in a friendly attitude toward the Americans. Thereupon the military governor was directed to bring the Sultan to Manila in order that his demands might be investigated. When the military authority with the Sultan and his suite in tow arrived there the medical officer in charge of a large hospital upon being told how the governor had lost the greater part of his control over the Sultan by telling him about the x-rays, suggested that during the conference the following day the Sultan should be taken on a tour of inspection through the hospital in order that he might see with his own eyes the things about which he had been told. This plan was adopted, and on the following day the Sultan of Sulu, accompanied by his attendants all clothed in their most gorgeous trappings, arrived for the conference.

At the proper time the tour of inspection through the hospital was begun. The medical and surgical wards, the laboratories and surgical operating rooms were all visited in turn. Finally, the Sultan and his retinue of attendants were ushered into the x-ray department where they were told that the American physicians would now actually show them the bones of their hands just as the military officer had told them could be done. At once the lights in the room were shut off and the x-rays were turned on. The Sultan was called to come forward and see his own bones. Tremblingly he complied and when he saw the image of the bones of his own hand on the fluoroscopic screen he nearly collapsed from fright. After he had recovered his equanimity to some extent he forced the leading members of his retinue to come forward and view their own skeletons.

After considerable talk with his attendants, he explained to the Americans that now he understood what great advances they had made and he pledged anew his allegiance to the Stars and Stripes. Since that day in the dark fluoroscopic room of a Manila hospital, the American authorities have had little trouble with the Sultan of Sulu.

This use of the x-rays by the medical officer in charge turned the tide of diplomacy in favor of the American authorities and thus avoided the necessity of sending an armed force to subjugate the Sultan's people. Thus this diplomatic method saved the lives of many American soldiers and secured the hearty cooperation of the Sultan of Sulu more effectively than could have ben accomplished by armed combat. This appears to be the first record of the use of x-rays in diplomacy.

A Course in Physiotherapy

THE next course of instruction in Physiotherapy will be given at Walter Reed General Hospital, Washington, D. C., beginning October 5, 1923, and continuing for a

period of four months. It is open to women who have had at least two years of training in an approved school of Physical Education. For further information, apply to: The Commanding Officer, Walter Reed General Hospital, Washington, D. C. Attention Department of Physiotherapy.

Midyear Meeting

THE MIDYEAR MEETING of the Radiological Society wil lbe held in San Francisco, June 22nd and 23rd, the Friday and Saturday preceding the meeting of the American Medical Association.

Those desiring to appear on the program should write to Dr. L. T. LeWald, St. Luke's Hospital, New York City, who is chairman of the program committee, or to Dr. R. D. Carman, President of the Radiological Society. The program is almost complete so immediate action is imperative.

The meeting will be held in Polk Hall of the Civic Auditorium, which has a seating capacity of 1,200. Commercial exhibits will be arranged in wide corridors immediately adjoining the meeting hall, and the scientific exhibits to two reception rooms each about 18 by 30 feet, through which one must pass to reach the meeting room.

Dr. W. E. Chamberlain, Stanford University Hospital, San Francisco, is local chairman of the committee on scientific exhibits and would like to have an exhibit of films from as many men as possible. If films can be mailed to him in advance it will greatly facilitate the work of the committee.

The Palace Hotel has been selecetd as headquarters and 100 rooms have been set aside for use of Society members. The prices of rooms are $8, $9 and $10 a day for two in a room. All rooms have baths. We are informed that those desiring accommodations should write at once since reservations are already at a premium.

Dr. M. P. Burnham is chairman of the local entertainment committee. Preliminary arrangements so far made by this committee are for a dinner and dance at the Palace Hotel the night of June 23rd. For Sunday, the following day, a motor trip is planned to the Santa Cruz big trees where luncheon will be served, thence to the beach at Santa Cruz. This trip comprises a scenic drive of about 100 miles each way. Golfers should note the kindness of Dr. Lloyd Bryan, Butler Building, San Francisco, who will, if notified, make arrangements for any member to play on the local golf courses. Dr. Bryan also announces that visiting cards will be issued to the Olympic Club, one of the attractions of which is the swimming pool. Besides these entertainments and courtesies the committee has arranged trips to Mt. Tamalpais, to the campus of the University of California and to that of Leland Stanford University.

DEPARTMENT of TECHNIQUE

The Design of Potter-Bucky Diaphragm Grids*

MR. R. B. WILSEY
Rochester, N. Y.

IN AN experimental study of the various factors governing the performance of the Bucky diaphragm grid, there appeared to be only one feature of design where appreciable improvement could be made on existing models, and that was in regard to the distance between the patient and the film.

It is a well-known principle in radiographic technique that the part radiographed should be as close as possible to the film, in order to obtain the sharpest definition and detail, and to minimize distortion; for instance, in x-raying the frontal sinuses, the forehead rather than the back of the head is placed in contact with the film holder or cassette.

Undoubtedly one of the reasons why Dr. Potter succeeded where others had failed was that he brought the distance between the patient and the film to a point where it gave improvement in definitions as well as in contrast. This factor seems often to be neglected or ignored in the construction of Bucky diaphragms as well as in the various types of plate changers. In the models of the Bucky diaphragm that I have had opportunity to examine, the distance between the cover of the diaphragm and the film ranges from 7/8 to 1 1/4 inches. Where the grid itself is only 3/8 or 1/2 inch thick and the total distance between patient and film is 1 1/4 inches it is evident that much space is wasted; it is surely unnecessary to allow 3/4 or 7/8 inch clearance for the motion of the grid.

The experimental investigation showed that the distance between the patient and the film had a marked effect upon the definition, and that to get the best definition this distance should be made as small as possible. It also follows that to get this same excellence of definition over the whole area of the radiograph, the cassette should follow the curvature of the grid, thus bringing all portions of the film as close as possible to the patient (Van Allen).

The problem in Bucky diaphragm design is to make the grid as thin as possible, and at the same time make the ratio of slit width to slit depth as small as possible.

In attempting to put into practice the conclusions of this study, two experimental Bucky grids have been constructed; the first has been described in a recent publication; the second is an improvement upon the first in that it is a finer meshed grid. By placing the lead strips closer together a higher efficiency in the removal of scattered radiation was produced and a higher radiographic contrast was secured. The cover is made of 1/32 inch aluminum, the grid itself is 0.16 (nearly 3/16) inch thick; the lead strips are three-thousandths of an inch thick and are held in place by strips of celluloid twenty-five thousandths of an inch thick. Supporting the grid over its whole area is a sheet of aluminum two hundredths of an inch thick, fastened at its edges to the aluminum frame. The ratio of slit width to slit depth is practically 1 to 6. The top of the

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 8, 1922.

curved cassette is of 1/32 inch aluminum. The clear space to be allowed above and below the grid depends upon how nearly the surfaces approach true cylindrical surfaces. It was found in this case that when the cover of the diaphragm and the cassette were so adjusted that the grid could travel without touching them that the distance from the upper surface of the cover to the film was ⅝ inch. Probably by increased care in construction this distance could be slightly reduced.

Comparison of the performance of this grid with that of commercial models showed clearly the advantage of the thin grid and curved cassette in giving sharp definition and fine detail. Radiographs were made of the same patient with the experimental diaphragm and with one of the ordinary type, using the same intensifying screens and giving the two films the same development, so that differences in the radiographs were due only to differences in the diaphragms. Several of these radiographs are shown in the scientific exhibit, and it is believed that an examination of these will demonstrate the value of reducing the distance between patient and film to the lowest practicable minimum.

In assembling the experimental grid, some difficulty was experienced in getting the lead strips lined up properly, and probably such a fine meshed grid would be rather expensive to manufacture. The writer would recommend the following dimensions as being the finest and thinnest that could be constructed without special difficulty: Thickness of grid ¼ inch; lead strips four or five thousandths of an inch thick, separated by strips of wood or celluloid forty or fifty thousandths of an inch thick. With such a grid, the distance between patient and film need not exceed 7/16 inch or ½ inch at the most, which is about half that of the average Bucky diaphragm at the present time. Such a grid would be quite efficient in removing scattered radiation, and by reason of the improvement in definition and detail, the usefulness of the Bucky diaphragm would be extended to types of cases where it cannot now be used with advantage.

CASE REPORTS

An Unusual Case of Tuberculosis

DAVID A. STEWART, M. D.
Ninette, Manitoba

H. S., laborer, aged 48, born in Iceland, began in November, 1918, to have symptoms of pulmonary tuberculosis. These included cough, expectoration, dyspnea and sweats.

On admission to Manitoba Sanatorium in January, 1919, he had well marked, moderately advanced pulmonary tuberculosis of the left side. Bacilli were found in the sputum. By June symptoms had cleared up and he had gained twenty-five pounds in weight. Against advice he went home, saying that he felt as well as ever, and gradually he increased his exertions until he was working eight or nine hours a day.

In May, 1920, he became suddenly ill. When readmitted to Manitoba Sanatorium on June 14th, he had already lost twenty-five pounds in weight, was suffering from general malaise, severe chills and sweats, temperature very definitely and constantly of the "reverse" type, high in the morning, low in the evening, sometimes with an excursion of eight degrees in the day. He complained of general soreness, aching bones, headache, and was restless and sleepless.

When admitted the only marked symptoms definitely referable to the intestinal tract were anorexia and occasional slight abdominal pain. Later he had gastric discomfort and vomiting after taking solid food. On milk diet he had very little digestive disturbance. Bowels were slightly constipated. There were no marked signs of active pulmonary disease. A perirectal abscess of sudden onset, when opened, discharged foul pus. Leukocyte counts ran from 12,000 to 24,000.

The abdomen was flaccid, somewhat distended with gas, but was not tender. Upon deep palpation a sausage-like mass was found in the epigastrium.

Plates after barium meal showed the stomach high, the lower border at the

Fig. 1—Barium meal, as seen in the plate taken at once.

Fig. 2—Barium meal, as seen in the plate at six hours.

level of the second lumbar spine, and a very striking defect in filling corresponding to about one-third of the pyloric end. The stomach was fairly movable.

With a diagnosis of malignant disease the patient was removed on September 17th to a general hospital where he died six weeks later.

A postmorten examination was made by Dr. S. J. S. Peirce of Brandon Man. from whase notes the following extracts are taken:

"All peritoneal surfaces were found studded with firm yellow nodules and the greater omentum was thickened by an accumulation of these. There was no sign of reaction around these nodules. They were suggestive at first sight of a general carcinomatosis of the peritoneum.

"The retroperitoneal and mesenteric lymph glands were universally enlarged and on section showed general soft caseation. The head of the pancreas was largely replaced by caseous glands and, bulging forward from it into the space between the transverse colon and the stomach, and dimpling the greater curvature of the latter, was a mass the size of a hen's egg. It was adherent to the stamach, and the stomach wall to a distance of one half inch from the mass was livid and indurated. Attempts to separate it from the stomach wall showed that the latter was perforated at this point by the mass which projected into the lumen of the stomach, and was there covered by a red pultaceous material which was in relation to an eroded blood vessel, and which was presumably a semi-digested blood clot. The mucosa of the pyloric end of the stomach in its posterior wall and lesser curvature was a sloughing necrotic mass with ill-defined borders. The appearance: Section of the mass showed caseous material which did not differ from the caseous glands at the head of the pancreas and elsewhere. The duodenum was patent and contained no tumor.

"*Diagnosis:* Phthisis pulmonalis tuberculous mesenteric adenitis, caseous tuberculous glands in head of pancreas with fistulous invasion of stomach, tuberculous peritonitis."

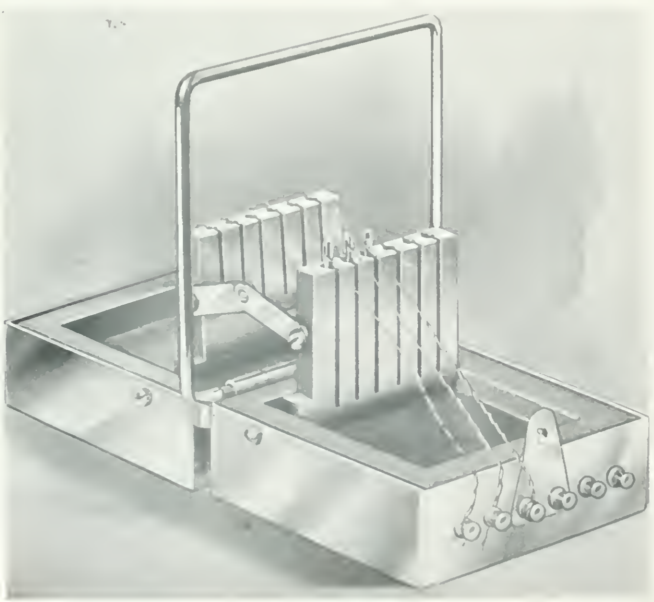
NEW EQUIPMENT

A New Holder for Radium Needles

Described by JOHN R. RANSON, M. D.
Invented by CHAS. H. HULL
The Radium Company of Colorado
Denver

THIS case provides a handy and compact means for carrying and sterilizing radium needles.

The object of this holder is to provide a container which shall be well adapted for retaining radium needles for transportation, for sterilization, and in proper position for threading without direct handling by the operator.



It closes like a cigarette case and the needles stand (points down) in slotted holes and may readily be threaded without removal from the case.

Briefly, the container comprises a holder or casing of two movably connected sections adapted to be folded together, provided with two needle retaining blocks so adapted that they may be automatically swung to and from a collapsed position as the casing is closed or opened. When the casing is opened the needles and the retaining blocks will be presented in vertical position and will maintain this position while the casing is open. In this manner the needles may be threaded without being handled or being removed from the retainer. A bail which serves to carry the holder when open also serves as a pintle for the connecting hinges.

When the container is in open position the two blocks containing the needles are disposed in horizontal alignment as shown in the cut · the backs of the sections engage one another to maintain this relation. The bail also assumes the upright position so that the device may be carried or dipped or even

boiled for sterilization. Small knobs or posts are provided on the outer forward wall of each section around which the ends of the threads or wires may be wrapped to avoid tangling, during sterilization.

Thus the device provides a means for the reception of radium needles, which properly presents the needles for threading, for sterilization and for ready access to individual needles for use. The slotted holes permit the sterilizing fluid to freely circulate about each needle.

When the device is closed the needles are retained in their sockets by the adjacent forward walls of the pockets into which they retreat as the device is closed.

The outer covering of the case is made of nickel-plated copper. This case is lined with one centimeter of lead which protects the operator from the soft rays emitted by the radium contained in the device.

This case is made up in two sizes. The smaller case holds twelve needles and when closed measures one inch thick, two inches wide and two and one-half inches high. The larger case holds sixteen needles and when closed measures one and one-fourth inches thick, two and one-half inches wide and three inches high.

The Victor Phototherapy Lamp

THE Victor X-ray Corporation has this to say with respect to its new Phototherapy Lamp:

As a preliminary announcement of this new Victor development, the following report from our research and engineering departments gives a comprehensive idea of the purposes in mind in the design of the lamp, the extent of experimental work and research involved, and the ultimate achievement.

As distinguished from the physiologic depression consequent to an exposure to radiations that are converted into heat, the visible radiations of luminous light exert a supportive and exhilarating constitutional activity.

The distribution of radiation issuing from tungsten filament lamps is Infrared and Visible (White) Light.

It is desirable that the energy striking the patient be as nearly as possible a maximum of visible light. It is therefore necessary to provide a special ventilating design that will quickly dissipate the bulk of the heat produced by the infra-red radiation.

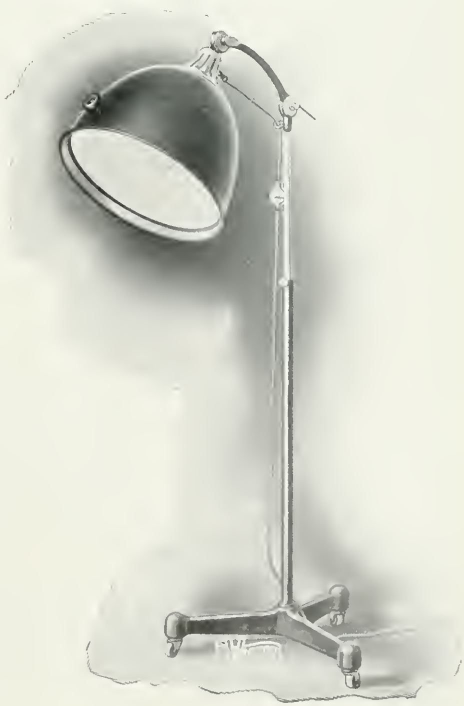
The Victor Phototherapy Lamp holds a new design designated as a double concentric parabloid reflector.

The reflector holds two jackets of the same design, an outer and an inner, entirely separated excepting at the attachment at the apex. The inner reflector presents an enameled and fluted surface, a combination agreed upon by illuminating engineers as the most desirable for the maximum insurance of dispersed reflection. That is to say, a breaking up of the ray so that a minimum portion of it is reflected back to the filament; thus avoiding the overheating of the filament and prolonging the life of the bulb. This effect can be obtained only through correct design of the reflector. The fluted surface of the internal reflector in the Victor lamp offers this decided advantage.

The space between the two channels amounts everywhere to about one-half inch and insures a continuous circulation of air which acquires a gentle flow and serves constantly to dissipate a great proportion of the heat.

This construction insures an efficient display of visible light with minimum heat accompaniment; conservation of practically all the reflected energy; elimination of reflex rays striking the tungsten filament of the lamp, which condition if present, lessens the useful light of the lamp (this breaking up of the reflection is obtained by the flutings on the internal reflector); complete absence of a thermal focal spot.

Especial care has been made in the selection of the illuminating bulb to in-



sure a glass that will transmit a maximum of useful rays.

The design and proportion of the Victor tungsten filament bulb are such as to make it in every way practical and convenient for every clinical usage indicated. With this unusual practicability it combines an extremely pleasing and finished appearance.

In this latest therapeutic creation the features presented accentuate the desirable qualities that make phototherapy successful; and it is fair to say that no other equipment exists in which the scientific evaluation of the factors that make for clinical efficiency have been more forcefully inculcated in the engineering evolution of the product than has been the case of this lamp. These high standards of scientific attainment are apparently responsible for the superior clinical excellency that may be derived from the use of the outfit.

The Victor Phototherapy Lamp is furnished on floor stand, or with wall bracket if preferred.

ABSTRACTS and REVIEWS

Diathermy in Pneumonia—A Report of Ten Cases. Harry Eaton Stewart, M.D., Med. Herald 42:90, March, 1923.

THE author reports these cases from his consulting service in the U. S. Marine Hospital, No. 21, New York.

In the hospital the results of diathermy treatment of pneumonia cases have led to the adoption of this form of therapy immediately upon the diagnosis of pneumonia being rendered.

Laboratory reports and clinical records, etc., accompany these ten reports. The relief consequent upon diathermy is listed as remarkable in all cases, the temperature in each one fell by lysis immediately after treatment. Two to three treatments per day can be given if proper technique is observed.

The author while rather conservative in his conclusions states that it is the belief of the entire medical staff that diathermy was of great aid in all these cases, and that the employment of this form of therapy in pneumonia cases is justified by results here recorded.

Relative Value of Surgery and Roentgen Ray in the Treatment of Hyperthyroidism. Edward P. Richardson, M.D., J.A.M.A. 80:820, March 24, 1923.

CASES of thyroid disease fall into two classes, those classified upon a basis of function (excessive or reduced), and those classified on a basis of pathologic changes in the gland itself. Chief among the latter are hypertrophy, hyperplasia, deposition of colloid, presence of adenomas, of malignancy or of inflammation.

This article is concerned with the type of case which shows an associated constitutional disturbance, seemingly due to a toxemia. The cause of symptoms, as far as known, is an increased output of thyroxin. This increased thyroid activity nearly always is found in exopthalmic goiter and in adenomatous goiter with hyperthyroidism.

In the Massachusetts General Hospital cases of hyperthyroidism are in charge of a committee made up of two clinicians, one roentgenologist and three surgeons. This committee began thus to function in October, 1919. They believe that the results in their cases justify the use of x-ray therapy in selected cases, namely, those where symptoms are an increased metabolic rate, rapid heart action, nervousness, loss of weight and weakness. Contraindications are "goiters with normal or reduced function requiring treatment for deformity, pressure on adjacent structures, potential malignancy, or potential hyperthyroidism * * *." There must be adequate modern x-ray equipment with ability to measure dosage and the means (basal metabolism, clinical observation) of estimating the benefit obtained must be employed in order to prevent myxedema being produced. An open mind that will employ surgery if necessary to a cure should be the property of every roentgenologist.

The x-rays, says the author, will accomplish the cure of a certain percentage of cases. In others it will make operation possible. "The harm that needs to be visualized comes, I believe, to these improved patients, through damaging effects of a slight persistent hyperthyroidism. The stage of improvement without cure I believe to be the serious phase of roentgen ray treatment; it should be constantly borne in mind." In another place he says: "My feeling is that they go on receiving organic damage, and that their life and usefulness is shorter than it would be from the more complete cure possible by surgery."

An X-ray Study of the Absorption of Tuberculous Exudate Within the Lung. Kennon Dunham, M.D., *and* Vera V. Norton, M.D. Am. J. Roentgenol. 10:112, February, 1923.

IN A total of 489 cases of bronchopneumonia observed at the Cincinnati Tuberculosis Sanatorium during the year from July, 1921, to July, 1922, absorption of tuberculous exudate was observed in 59 cases which the authors unhesitatingly diagnosed as pulmonary tuberculosis. Six of these cases are reported in detail in the original paper.

The authors state that it is their belief that caseous tubercles in the human being can heal by resolution and finally disappear completely.

Roentgen Diagnosis of the More Important Tumors of the Long Bones. Bernard H. Nichols, M.D., Surg. Gynec. Obst. 35:301, September, 1922.

BONE tumors may easily be diagnosed roentgenoscopically by means of the following plan and classification:

I. *Origin:* a. Medullary—Sarcoma, carcinoma, hypernephroma, myeloma, fibroma, bone cyst, echondroma, giant cell sarcoma.

b. Cortical—Periosteal sarcoma, osteosarcoma, osteoma, enchondroma, ossifying hematoma, myositis ossificans, bone cyst (rare), exostoses.

II. *Bone Production*—Periosteal sarcoma, osteosarcoma, osteoma, exostoses, ossifying hematoma, myositis ossificans, enchondroma, bone cyst after fracture.

III. *Condition of Cortex:* a. Expanded—Enchrondroma, bone cyst, giant cell sarcoma, fibroma.

b. Destroyed—Sarcoma, carcinoma, hypernephroma, myelema, periosteal sarcoma.

IV. *Invasion:* a. Invasive—All malignant tumors.

b. Not Invasive—All benign tumors.

It may not always be possible to determine each of these points but usually two or more of the cardinal points may be learned from the plate and will aid in the process of elimination. These

points, however, do not apply to flat bones or to the vertebrae.

Bone destruction and bone production may be determined. The former may be considerably altered by surgical interference or by trauma.

Location can always be determined. Sarcoma is usually located at the end of the bone, carcinoma will more often be found at the point of entrance of the nutrient foramen. Cartilage seems to be a barrier; malignant tumors do not cross a joint and, therefore, if the lesion involves both sides of the joint it is benign. Age, of course, is an important factor in differential diagnosis.

A malignant tumor originating in the medullary canal develops by cell division, invades the cortex of the bone and the surrounding tissues and produces a spherical growth.

Infectious processes extend up and down the medullary canal, following the Haversian canals and leaving areas of healthy bone. After the infection subsides new bone formation will appear at the periphery of the lesion producing dense periostitis and a thick cortex. In malignancy there are no abating symptoms to allow repair.

A benign tumor will expand the cortex which will be kept intact by a small amount of new bone formation. A thin dense line will be seen at the limit of the lesion in the medullary canal. These lesions tend to present a rather cylindrical contour extending up and down the medullary canal.

About four pages of text accompanied by 15 illustrations describe the main points in the pathological characterization of the following bone lesions: (1) Sarcoma, round cell, spindle cell, periosteal and osteosarcoma. (2) Carcinoma. (3) Myeloma. (4) Benign tumors: giant cell sarcoma, bone cysts, fibromata, chondro-osteoma, osteochondroma, osteomata, exostoses, ossifying hematoma, myositis ossificans. (5) Tuberculosis. (6) Syphilis.

Periosteal Sarcoma in Association with Osteomyelitis. Report of Three Cases. R. L. Rhoades, A. B., M. D., F. A. C. S. Surg. Gynec. Obst. 35:440, October, 1922.

THREE cases of large round cell sarcoma of periosteal origin, associated with infection and necrosis of bone are here reported. In one of these cases the author feels sure that osteomyelitis preceded sarcoma. The report is inspired by Dr. Bloodgood's alleged statement that he had never observed sarcoma in osteomyelitis.

All three patients were females, two were white girls aged 12 and 14 years, and one was a colored girl of 20 years of age. Each case involved the left tibia.

There was in no case a history of trauma or illness. Two of the patients experienced local pain, the other did not. All three showed a staphylococcus aureus infection. Two had a rapid pulse and a high fever.

Mid-thigh amputations were performed upon all three. One patient is dead, the other two are well at present, more than a year after treatment.

A Roentgenographic Study of the Sella Turcica in Normal Children. Murray B. Gordon, M.D., F.A.C.P., *and* A. L. Loomis Bell, B. S., M.D. Endocrinology 7:52, January, 1923.

THE four pages of text are summed up in the following conclusions: "(1) *Shape of the sella turcica.* The sella turcica in normal children can be classified in a general way by means of the roentgenogram into three groups according to shape: *A*, circular; *B*, oval; and C, flat and saucer shaped, with modifications as explained in the text. Groups *A* and *B* were found in all ages, while group C was practically limited to the first three years.

"(2) *Shape of sella as to size of the head.* The shape of the sella has no significance except in the case of the flat group C type. This type is always found in small heads, but it does not necessarily follow that all small heads exhibit this type.

"(3) *Size of sella in comparison with age of the child.* There is a marked variation for each age, both as to height and length of the sella for that particular age. The average height and length of the sella shows a comparatively rapid increase in the first two years with a gradual yet irregular increase from then on up to the age of 12. There is a tendency for the average height increase to follow the average length increase.

"(4) *Size of sella as to size of head.* There is apparently no relationship between the size of the head and the size of the sella based on head measurements.

"(5) *Appearance and size of sella as to sex.* There is no difference in the occurrence of the three groups between the heads of boys and girls. There does not seem to be any influence of sex on either appearance or formation of the sella. The sella of girls, however, were greater in both length and height."

Secondary Os Calcis. Arthur Krida, M.D. Am. J. Roentgenol. 10:752, February, 1923.

DR. KRIDA reports the removal of a secondary os calcis which had become loosened in its situation and which predisposed the patient to recurrent sprains of the right foot. The pain and swelling were localized on the dorsum in front of the external malleolus.

Dwight's *Variations of the Bones of the Hand and Foot* is quoted on secondary os calcis. Dwight and also Geist are credited with having found two such bones; Pfitzner in the examination of 840 feet found 16 such bones.

The author's conclusions are as follows: "From the clinical standpoint, the separate ossicle described by Pfitzner may be accepted as the typical secondary os calcis. Its occurrence in two per cent of his large series of dissections need not lead to the expectation of finding it frequently in routine roentgenograms of the foot, as the smaller and less well developed specimens might easily escape demonstration.

"It would seem that a well developed secondary os calcis, acting like a wedge in a series of complicated movements in the middle of the tarsus would be peculiarly liable to avulsion or displacement."

Some Observations on Radium Therapy in Cancer at the Institute of Radium, Paris. Malford W. Thewlis, M.D. Rhode Island M. J. 6:39, March, 1923.

THE Institute of Radium of Paris University has been made "the foremost center of the world for the study of radium" by the fact that Madame Curie's laboratory is there associated with the biologic laboratory of Dr. Regaud.

Dr. Regaud's collaborators at the Pasteur Laboratory are Drs. Lacassagne, Jolly, Ferroux and Coutard. Experiments upon animals and the histologic examination of patients' tissues are all made here. At the Pasteur Hospital Dr. Regaud is assisted in making applications of treatment by Drs. Cesbron, Monod and Richard, while the emanation tubes used are prepared daily under Madame Curie's direction.

Dr. Regaud's technique is different than that prevailingly used and his work in connection with carcinoma of the tongue and the uterus is said to be remarkable.

Histologic examination of every case is made before treatment. The principle of treatment is destruction of all cancer cells without producing any grave lesion of the anatomic elements of the growth itself or of the tissues surrounding it.

Though 100 mgs. of radium for 10 hours represents the same dose as does 10 mgs. for 100 hours, yet a difference in intensity and time will produce different results according to the type of

lesion under treatment. Regaud's rules for intensity are given as follows: "(1) Tubular epithelioma of the cervix, with the intensity of 100 to 150 microcuries of emanation per hour per focus. (2) Globo-cellular sarcomata and lymphosarcomata with the intensity of 50 to 100 microcurie hours. (3) Carcinomata of the breast with the intensity of 25 to 50 microcurie hours. (4) Epidermoid epithelioma and tumors of connective tissues rich in fundamental substances, with the intensity of 5 to 25 microcurie hours.

"One should seek to obtain the desired result in one treatment only * * * because in the course of successive treatments healthy tissues become more and more vulnerable while the cancerous tissue becomes more and more unaffected."

Regaud and his collatobators are said to be probably the first to use a radiation of feeble intensity prolonged for from four to ten days without interruption.

The reason for this prolonged treatment is that cells are most sensitive to radioactivity at the moment of nuclear division and to complete the cycle of destruction the radiation must be prolonged. No ill results by way of reaction or sloughing will follow if proper filtration is used. "The secondary rays produced by the various metals used for filters are capable of doing much damage, but if platinum gold and aluminum are used the secondary rays cause little harm. In surface applicators the lead filters the beta rays of the radium, and the aluminum and cork filter the secondary rays produced by the effect of radium on the lead."

Regaud, in certain cases, used bare emanation tubes, but most often he uses platinum iridium needles containing tubes of radium emanation though he prefers salts of radium because of their greater constancy and plans to use the salts entirely as soon as a large enough supply can be procured.

In radium puncture for cancer of the tongue local anesthesia renders the procedure practically painless. The needles are left in place for eight days, the dose being "20 to 20 millicuries destroyed in eight days" (one millicurie of emanation of radium destroyed is the equivalent of 132 milligram hours with radium sulphate).

Regaud believes it is of no practical value, in cancer developing from syphilis, to give treatment for syphilis.

Regarding cancer of the lip his conclusions are as follows: "* * * epidermoid cancer of the lips is curable by roentgenotherapy and by Curietherapy (radium therapy) even when the neoplasm has reached a great development. Curietherapy is in every respect preferable to roentgenotherapy. In thin cancers, Curietherapy by superficial application suffices; in thick cancers radium puncture is more satisfactory or even indispensable. The very good results obtained in cancers which had greatly outgrown the possibility of operation permit us to consider as easy the cure by Curietherapy of cases operable and *a fortiori* the cases in the beginning." Good technique is indispensable. Glandular operations if operable must be treated surgically.

In uterine carcinoma a filter of 0.2 Al in a blind catheter of pure gum rubber is used and the dosage varies according to the type of lesion. Gold tubes with 15 per cent platinum are also used in these lesions.

A Plea for Radiation as an Alternative to Surgery. D. de Vos Hugo, M.B., C.M., South African Med. Rec. 21:29, January 27, 1923.

RESULTS secured by radiotherapy in cases of epitheliomata, carcinoma of the esophagus, uterine hemorrhage and cancer of the cervix are recounted.

Pancoast, Abbe, Quick, Janeway, Biggs, Gussenbauer and Hotzknecht are cited as authorities upon the treatment of epitheliomata, and Beck and John G. Clark upon carcinoma of the esophagus, W. J. Mayo and Howard Canny Taylor upon carcinoma of the cervix.

The author concludes by a general statement regarding the limitations of radium, followed by a plea for unbiased consideration of its merits.

Anatomical Cross-Section Charts in Estimating X-Ray Dosage. Arthur U. Desjardins, M. D. Am. J. Roentgenol. 10:134, February, 1923.

DR. DESJARDINS says that to correctly administer x-ray therapy requires (1) "Knowledge of the location, extent and type of the tumor, and its relation to surrounding structures, as well as of the existence and location of metastatic foci. * * * (2) Knowledge of the quantity of rays of a definite quality, or of 'effective wave-length' necessary to deal successfully with a given type of tumor. * * * (3) Knowledge of the absorption or penetration characteristics of rays of a given 'effective wave-length.' "

There is no such thing as a "cancer dose." There is not enough known about the biophysical and pathological phases of tumor growth and about the quantitative and qualitative effects of x-rays on different tumors to make knowledge of a cancer dose possible.

If the roentgenologist is sufficiently trained in the use of physical instruments and can intelligently use the data obtained by his own efforts he may figure the penetration for himself, and the author has worked out anatomical and cross-section charts by which the ratio of depth dose to skin dose may be determined with relation to the average human figure.

Composite contour tracings at nine different levels were made of 12 female and 12 male subjects, and these were used in making the charts which "will assist the radiologist in applying or studying penetration data with relation to the average patient, but will not remove the necessity or advisability of measuring patients, especially such as are patently larger or smaller than the average. By means of a measuring chartg raduated in centimeter squares and printed on transparent celluloid, it becomes a simple matter quickly to obtain any measurements desired."

The original paper is illustrated with reproductions of cross-section charts.

Deep X-ray Therapy. Reginald Morton, M. D. Am. J. Roentgenol. 10:119, February, 1923.

DR. MORTON of London in this paper characterizes the work of Sitz and Wintz as the "first complete system of x-ray therapy having a sound physical and biological basis," and as the first real step toward a "cure for cancer." Tribute is also paid to Dessauer's charts.

Dr. Morton emphasizes tellingly the fact that the roentgenologist who is a master of his specialty will get a higher percentage of favorable results than will the mediocre man, though the latter may have all the very latest equipment in the market. As an illustration of his point he narrates the story of the famous Edinburgh surgeon who, in a case of emergency, excised an astragalus with only his pocket knife and a screw driver. The subject of the operation walks with a scarcely perceptible limp and the operation, from every point of view, has been a great success.

Three remarkable cases are reported from the writer's practice. One was a case of carcinoma of the breast, one a carcinoma of the esophagus, one a case of malignant prostate, and one a sarcoma of the thorax. These all received x-ray therapy, and though they were all regarded as hopeless at the time of the first treatments, March, 1921, to January, 1922, they are now clinically well.

Some of the Essentials of Dental Radiography. R. A. Albray, D.D.S. Dental Cosmos.

AFTER proper technique in taking dental films the next thing is their proper interpretation, "a task which at

times assumes the proportions of a Chinese puzzle." This is the point at which it is necessary to discriminate between a poor film and a good one and between one good enough for the purpose and one quite worthless.

"Some radiographs are, when studied with the clinical findings of the case, possible of almost instant diagnosis; others have to be carefully inspected with the magnifying glass, and several films of the area must be taken from varying angles, with different lengths of exposure and tubes of hard and soft quality before a satisfactory diagnosis can be made.

"In studying radiographs do not confine yourself to the condition of the bone about the teeth to the exclusion of everything else. Rarefied areas are only a part of the story which the radiograph tells, and every dark spot at or near the apex of the root of a tooth is not necessarily an abscess or focus of infection. * * * When examining a radiograph some of the particular conditions which should be looked for aside from the favorite rarefied area are thickening of the bone about the root apices due to traumatic occlusion, pyorrheal absorption of the alveolar process, carious cavities in the teeth, secondary caries under fillings or the edges of crowns, pulp stones, exostosis of the roots, fragments of roots of extracted teeth, impacted or unerupted teeth, foreign bodies, necrotic or cystic areas.

A few of the physiological structures to observe and not confuse with pathological conditions are the mental foramen, inferior dental canal in the mandible, the anterior palantine canal, antrum, nasal cavity, coronoid process of the mandible. * * * Do not mistake areas about young teeth just erupting or recently erupted for abscesses. Teeth which have been undergoing orthodontic manipulation will frequently show what appears to be pathological lesions in the bone about their root apices."

For the sake of progress the author urges that clinical and radiographic findings be compared with the actual conditions found upon operation.

Indications for Radiodontic Examinations. L. R. Mann, D.D.S. International J. Orthodontia.

THIS author in urging the necessity of x-ray diagnosis says: "* * * in most cases the only way I know to tell whether a complete x-ray is necessary is to make the examination first." Too frequently it is thought that if the tooth responds to the vitality test then x-ray is not needed, but apical abscesses are not all that the x-ray may reveal; in fact, the use of the x-ray in diagnosis will eliminate 75 per cent of guess work on the part of the dentist. The x-ray is absolutely necessary to determine periapical abscesses. In root canal work guess-work is eliminated by intelligent use of the ray. An x-ray is advisable in all cases of so-called pyorrhea.

Attention is called to the less common uses of the x-ray as required in restorative work, etc.

Injuries from Roentgen Rays in Deep Therapy. Herman Wintz, M.D., Erlangen, Germany. Am J. Roentgenol. 10:140, February, 1923.

LOCAL injuries from the x-ray result from exceeding the limit of tolerance of tissues and from the defects of present radiation technique. The expert and conscientious man will not limit his work to poorly trained attendants and he will notice at once any disturbance in the apparatus. X-ray burns will, therefore, not be likely to occur in his practice though they cannot be avoided with absolute certainty.

The varying density and size of the body part irradiated increases the difficulty of administering proper dosage. Values obtained by the water phantom cannot be the exact equivalent values for a like volume of the human body because of the varying composition of different tissues.

In treating cervical cancer the bladder should be emptied every hour during the radiation, otherwise its anterior wall may approach too near the rays, and blistering, edema, or even ulcer may result. The posterior rectal wall in thin patients may also be easily injured as it lies within reach of three fields of entrance.

The small intestine is less likely to be injured but it may be if some of the loops have become fixed by pelviperitonitic adhesions to each other and to the uterine tumor.

In treating the supraclavicular glands and the lymphatic chains along the sterno-cleidomastoid muscle the larynx and the trachea may be injured. This danger is particularly marked if both sides of the neck must be rayed with a dosage of 95 to 100 per cent at a depth of two centimeters, for if the two fields converge at the center then 150 to 160 per cent will strike the laryngeal mucosa. In some types of cases this danger may be avoided by raying only one side, with an interval of several days before the other side is treated. This, however, cannot always be done, for example, in laryngeal carcinoma with infiltration of adjoining parts.

Additional radiation intensity due to uncommon secondary radiators, such as remnants of a barium meal, or collargol, or fecal masses may produce trivial injury; but more or less severe injuries may result from persistent pressure upon the irradiated part, e. g., from the corset, the application of icebags, hot compresses, or from chemical changes resulting from use of internal remedies, from traumata or acute or chronic disease present at the time of radiation.

Irradiated tissues have a lessened resistance if the quantity of rays applied has exceeded, by so much as one-third, the limit of tolerance typical for the cells.

The knowledge of these areas of lessened resistance is of great importance, "for it explains the peculiar injuries which have been observed after correctly applied treatments, and particularly the so-called late injuries."

General injuries are those done to the blood and those which result from inhalation of the air of the x-ray room. Chronic injuries to the blood are due to the effects of the x-rays as well as to this air.

Radiotoxemia deserves more attention and serious study than it has so far received. Actual changes in the biochemistry of the cells take place, disturbing their function, and there is a nervous factor involved. If the patient is grounded or screened by a faradic cage the radiotoxemia is less severe.

Clinical Results of Treatment of Malignant Diseases by X-rays. Lancet 204:185, January 27, 1923.

A DISCUSSION of this subject took place January 22nd, at a meeting of the Medical Society of London.

Dr. Robert Knox in his discussion said that no true estimate of the efficiency of x-ray treatment could yet be given. Surgery he believes must be the first recourse whenever it is possible. X-ray is a very helpful adjuvant to surgery and a palliative in hopeless cases. He warned his hearers against inaccurate diagnosis, e. g., he believes that syphilis is at times inexcusably mistaken for malignancy. Of late Dr. Knox has adopted the practice of giving a small preliminary dose of radiation to determine the patient's reaction. He thinks it is perhaps better to divide the large dose into six sittings with a day or two between each one. This method is being successfully followed at the Cancer Hospital in London. The new method of massive dosage produces a more rapid result but is risky and more uncomfortable for the patient and moreover, to stand it well, the patient's general condition must be very good.

Advances in Radiation Therapy of Deep-Seated Tumors. Rollin H. Stevens, M.D. J. Michigan M. Soc. 21:124, March, 1923.

THIS paper gives a brief review of the physics and history of radiation therapy.

The Angstrom unit is defined and the various wave lengths of the different forms of electro-magnetic waves are given from the wireless wave to the gamma wave lengths of radium rays.

The advancement in the technique of radiotherapy is lightly sketched and the problems of present day radiotherapy are discussed. A generalized report is given of cases of malignancy treated by this author.

He summarizes his view of cancer therapy thus: "In spite of the development of radiation the surgeon is still needed in the cancer world. * * * We doubt the expediency of radical operation in most cancers for the following reasons: (1) The removal of all the reproductive elements of cancer by the most radical surgical operation is probably impossible in the great majority of cases. The history of the surgical treatment of cancer substantiates this statement. (2) There is much evidence that the connective tissues about a cancer are important factors in the cure of the disease and their help can be greatly increased by stimulation with radiation. These tissues, therefore, should not be removed surgically or destroyed by any other means. (3) Radiation destroys cancer cells, directly or indirectly. Whether directly or not it probably stimulates the connective tissues about the growth so that they proliferate, crowd out the cancer cells, and possibly secrete immunizing biological substances against cancer. (4) Metastases are usually more sensitive to radiation than the primary growth. An exception to this is where the metastases is in the neck. Therefore, if surgery is required we believe it should be limited to the primary growth, and sterilization, so to speak, of the cancer field should be left for radiation to accomplish."

Pre-operative radiation four to five weeks before surgery, the author, believes, is better than postoperative radiation. The field is safer for operation and though immediate healing may not be as rapid as it otherwise would be the ultimate result is just as good.

High voltage x-ray therapy of deep seated cancer "should probably be used in preference to surgery in all cases of cancer of the uterus, about the mouth, and in inoperable cancer in other regions. In cancer of the breast and in several other locations it should probably be used in conjunction with nonradical surgery."

The Actinic Ray. Howard A. Plank, M. D. From a paper read at Omaha December, 1922.

THE author says this of the ultraviolet rays: "Don't depend upon the ultraviolet rays alone for every disease and case, because it will not cure your cases. I do not like the word 'cure.' If we arrest some of these things it is all that we can do. Many get well and you may have a recurrence in six months, or years. They get rid of their symptoms, their digestion is all right and they are happy.

"Use everything else you know to be of any benefit to that particular type of case. There is no reason while using ultraviolet rays to exclude any drug you have ever used, because one does not interfere with the other."

He reports successful treatment of psoriasis, though not every case will yield to treatment. Abscess in osteomyelitis, mastoids refusing to heal after operation, erysipelas, old varicose ulcers, lupus and light tuberculous lesions are among the conditions and diseases that he has successfully treated with the ultraviolet rays. He reports a case of stitch abscess following an appendectomy which was greatly helped by ultraviolet treatment.

Pernicious anemia and hay fever while relieved to some extent, the author does not regard as very amenable to ultraviolet treatment.

He warns against using these rays upon boils until after drainage is established, after that they aid in the recovery.

Drawing attention to the research work at Johns Hopkins which has proved that the ultraviolet rays are as efficacious in rickets as is codliver oil he cites a case of anemia where the hemoglobin of 15 per cent was brought up to 40 per cent within thirty days and the red cell count greatly increased, and he remarks that there is no doubt of the general systemic improvement under ultraviolet treatment.

Differences Between Thermotherapy Light and Actinic Rays. T. T. Harris, M. D., *and* R. E. Mowen. From a paper read in Omaha, December, 1922.

IN A technical discussion Mr. Mowen said that the term, "actinic ray lamp," is inaccurate when an ultraviolet ray lamp is meant. Ultraviolet is one form of actinic rays. Neither should the term "deep therapy lamp" be used when a thermotherapy lamp is meant as the latter applies to rays between 4040 and 7700 Angstrom units and the former does not apply to these rays.

Ultraviolet rays besides having a bactericidal and a stimulative effect have two other effects, namely, they raise the opsonic index and increase the general metabolism.

In the general discussion following this paper the subject of treatment of varicose ulcers by ultraviolet therapy was brought up. It was agreed that in cases where environment or temperament made it impossible to keep the patient in bed that the ultraviolet rays would heal the ulcer, without, of course, any effect upon the etiology, but with the ulcer healed and proper support provided the patient could be made comfortable.

Dr. Mullins reported that he had found that eczemas and ringworms would disappear almost magically by the use of ultraviolet rays. The importance of dietary treatment in eczema was stressed.

Actinic Therapy in Rickets and Malnutrition. Newell Jones, M. D. From a paper read at Omaha, December, 1922.

IT IS stated in this paper that 65 per cent of the children under eighteen months of age who live in the middle western part of this country have rickets in some degree or other, and that this condition is found much more frequently among children of the well-to-do than among the poor.

Dr. Jones believes with Bifield and Dean that early rickets predisposes to later chronic upper respiratory infections. Rickets produces deformities which prevent sinus drainage, produces a hyperemia of the mucous membrane throughout the whole gastro-intestinal tract, and results in a general muscular relaxation. All these conditions make the child much more susceptible to colds.

Hess of New York who uses direct sunlight in the treatment of rickets has secured most happy results. Pure codliver oil and the actinic ray will accomplish the same results. Direct sunshine must be from outdoor exposure and the whole body must receive a good coat of tan from the treatment to be of any effect, therefore this is an unfeasible method in any but a warm climate as the sunshine must be unfiltered by glass. In his treatments Dr. Jones uses the air cooled lamp. Exposure at first is from one-half to three-quarters of a minute at a distance of from 20 to 24 inches, the child lying prone and the treatment being given both front and back. To avoid frightening the child it is taken into the treatament room but not given any treatment the first time, so that it may grow accustomed to its surroundings there.

Two treatments per week are given at first and the number is gradually increased until one is given every day.

Distances must not be less than 10 to 18 inches. Some children can be worked up to a three and one-half minute exposure, one must be guided in this by the reaction. The whole body must be stripped, the eyes are protected by gogggles or a bandage. The fair-skinned child as a rule can stand only about fifty per cent of what a dark-skinned child can receive.

In two or three weeks results will begin to show in better appetite, better functioning of the gastro-intestinal tract and a cessation of the sweating which is so characteristic in these cases. Later on the teeth will begin to hurry along, but bow legs, the doctor remarks, are not made over in a day. The hemoglobin percentage and the red blood cell count are greatly increased by the treatment.

Every case of rickets in a child, under eighteen months of age, treated by Dr. Jones has improved if given a fair trial. Two very extreme cases are reported as cured. After eighteen months of age treatment will accomplish nothing except to build up the general nutrition of the body.

Actinic Therapy as a Bactericidal Agent. M. Wood, M.D. From a paper read at Omaha, December, 1922.

ULTRAVIOLET rays stimulate the glands of the skin and this effect together with their bactericidal effect is why they are of such value in the treatment of skin diseases. The water cooled lamp is more bactericidal than is the air cooled one.

In treating acne the writer treats portions of the face, about two and one-half inches square, at different times. No filter is necessary, of course, but he is careful to avoid an erythema of the ear. The pus is first expelled by mechanical means and then fifteen to twenty minutes raying is given with the deep therapy lamp. This is followed by intense treatment with the water cooled lamp to secure a regenerative erythema. This process is repeated twice a week and when the consequent scaling is quite completed another dose may be given if the condition seems to require further treatment. The cure is permanent.

Skins vary in their reaction but the most harm one can do is to blister the skin heavily as in sunburn. The author advises light dosage at first for if a heavy blistering dosage is given the patient becomes alarmed, however, if a heavy dosage seems necessary the patient should be warned what to expect.

Ulcers due to bacteria yield to ultraviolet therapy. Local treatment is given with the water cooled lamp using the one or one-half inch localizer. This is immediately followed by a general body treatment front and back with the air cooled lamp. Intensive local treatment is advised for these lesions, despite the discomfort caused.

Corneal ulcers have been successfully treated. Light raying is used, so pressure is not employed. In a case reported in this paper exposure for one-half minute at close contact was given, which resulted in clearing out the pus; a second treatment was given on the second day with one minute exposure. Complete healing resulted.

Further Observations on the Radium Treatment of Cancer of the Esophagus with a Review of Forty-four Cases So Treated. Walter Mills, M. D., *and* John B. Kimbrough, M. D. Am. J. Roentgenol. 10: 148, February, 1923.

THIS paper reports the results of radium treatment in 44 cases of cancer of the esophagus.

The technique and dosage used are given in detail in the original paper. Most of the patients were lamentably late cases, none were what might be called very early ones.

No case has resulted in cure, nor is any cure expected in the present status of therapy, but the authors are hopeful of the future. The treatment is unquestionably palliative, it lessens the agonies of thirst and hunger and prolongs the lives of those treated. In all but three of the cases dysphagia was relieved, very strikingly in some cases. The longest duration of life after treatment was three and one-half years, another patient lived two years and four months, and another one lived one year and seven months. All other deaths (thirty-four in all) occurred within a year after treatment.

Preliminary Report on the Treatment of Pertussis by the X-ray. Henry I. Bowditch, M.D., *and* Ralph D. Leonard, M.D. Boston M. & S. J. 188:312, March 8, 1923.

ROENTGENOTHERAPY has been tried by the authors in 26 cases of active pertussis. The patients ranged in ages all the way from three months to 40 years of age and were in varying stages of the disease. Three or four applications of the ray were given at intervals of two to three days. The dosage was regulated according to the age and the total given was well under the erythema dose.

The results secured cannot be attributed to accident, say the authors, and they are now making further study of this form of therapy and the results of the study will be reported as soon as ready for publication.

Meanwhile the preliminary account reports that in a few cases after two or three applications of x-ray the spasms and whoops disappeared entirely and the patients were clinically well. On the other hand a few patients secured no relief whatever. Seventy per cent were relieved in that the spasams decreased markedly, patients who had had from 14 to 18 spasms in the twenty-four hours being relieved to the extent of having only one or two a week.

A Case of Primary Carcinoma of the Female Urethra Treated with Radium. Lawrence A. Pomeroy, M. D., *and* Frank W. Milward, M. D. Surg. Gynec. Obst. 35: 355, September, 1922.

THE total number of reported cases of primary carcinoma of the female urethra the author found to be 67.

Urethral caruncle, a common affection in women, may be followed by malignancy; hence, its early recognition is important.

Radical extirpation of the urethra is seldom necessary but when it is it should be thorough, even to the extent of resection of the bladder if necessary.

All operations should be followed by radium; Kelly and Burnham are quoted as two authorities who recommend this procedure. Advanced cases may be relieved by radium or x-ray treatment.

Diathermy in the Treatment of Tumors of the Lower Urinary Tract. B. C. Corbus, M. D. J. Urology 9:203, March, 1923.

FULGURATION and diathermy are thus described: "Fulgration or dessication is produced by the unipolar action of sparks of high frequency and high tension (Oudin's current), and produces only a carbonization of the tissues, thereby lessening heat penetration. Thermic electrocoagulation (diathermy) is the application of thermic properties of bipolar currents of very high frequency and low tension (d'Arsonval current)."

Ten minutes exposure to 113° F. renders impossible the successful transplantation of malignant cells but normal tissue cells can stand from 132° to 140° F.

The technique is described with the aid of diagramatic drawings.

The author's conclusions are that: "Diathermy can be used to destroy cancer in areas that are totally inaccessible by any other procedure. In order to accomplish successfully the destruction of malignant tumors with

thermic-electrocoagulation we must use a current that is low in voltage and high in amperes, only enough voltage being used to drive the current through the tissues. This of course varies in different parts of the body. In coagulating tumors of the bladder by the low infusion of heat 1500 milliamperes are as a rule sufficient."

The general discussion following the reading of this paper brought out many useful points in technique.

The Treatment of Cancer of the Bladder by Radium Implantation. George Gilbert Smith, M. D. J. Urology 9:217, March, 1923.

DIRECT application of radium to the surface of the growth in cases of cancer of the bladder has not yielded satisfactory results in the author's experience, and so in November, 1919, he began the practice of implanting tubes of radium emanation in nearly all cases. The results in some cases have ben very encouraging and in some others very discouraging.

Sloughing resulted in infection and the death of several patients. To avoid this the patient's probable resistance to infection must be taken into consideration and "in less favorable cases use a smaller dose of radium, drain the bladder longer after operation, support the circulation and promote diuresis."

The method of application has been "by intravesical or transvesical approach in small tumors, and by cystotomy and implantation under full sight in more extensive growths."

A brief summary of 11 cases is given and the pitfalls encountered in their history are noted. The author's conclusions are as follows:

"The implantation in bladder cancer of bare tubes of radium emanation of low potency, or of radium bearing needles of 5 mgm. each, will cause complete necrosis of the tumor, provided they are inserted 1 cm. apart and are so placed that the entire periphery of the growth is brought within reach of rays of lethal power. (2) Two classes of cases are suitable for this treatment: small single papillary carcinomata into the base of which bare emanation tubes may be deposited by intravesical methods; sessile carcinomata or the bases of large fungating growths after destruction of the tumor by cautery, into which radium may be implanted through a suprapubic cystotomy. (3) It is inadvisable to bring about the necrosis of a tumor more than 3 or 4 cm. in diameter, as the absorption of toxins from the infected slough is likely to prove fatal. (4) The problem in treating cancer of the bladder by this method is to use enough radium to destroy the cancer but not enough to destroy the patient. (5) A number of cases of cancer of the bladder in whom the growth could not have been excised successfully, have shown complete disappearance of the growth, clinically, following the implantation of radium."

A New Method of Applying Radium Through the Cystoscope. Leo Buerger, M. D. J. Urology 9:227, March, 1923.

THE author believes that he has perfected an intensive and efficacious method of applying radium, a method that will eliminate the necessity of leaving the cystoscope in the bladder.

Special needles and applicators are used with either the author's operating cystoscope, a direct or oblique vision cystoscope, or the author's oblique vision radium cystoscope. Technique and apparatus are described in detail.

Dr. Buerger says, "Time will not permit me to discuss at length all the correct indications for the use of radium in the bladder. But as a urologic surgeon, and one who has treated carcinoma of the bladder almost exclusively in a surgical manner for more than fifteen years, one who has been able to witness the results of partial resection with or without unretral reimplantation, complete cystectomy and cauterization, I can unqualifiedly express the opinion that not only has the cystoscopic application of radium a sphere of usefulness, but that radiosurgery—the combined administration of radium and surgery—is the best therapy at our disposal today for such malignant growths.

"As for cystoscopic radium therapy its field is three fold: First, for the treatment of carcinoma alone without surgery; second, for the treatment as a preliminary step to surgery; third, for the treatment of metastases."

A report upon cases so treated is contemplated for the near future.

Electrotherapeutics in Prostatic Conditions. Victor Cox Pedersen, M.D. J. Urology 9:249, March, 1923.

THIS paper is a historical and critical review of the work of the urologist and electrotherapeutist during the last quarter of century.

The writer states that "in general all prostatism must be recognized as to the fact and degree of congestion, inflammation, abscess, hypertrophy, neoplasm or calculus." After certain pathological changes have occurred electrotherapeutics cannot confer any permanent benefit.

Twenty-five pages are taken up with the description of faradism, galvanism, sinusoidalism, ionization, static wave, high frequency and radiotherapy.

In the early days of electrotherapeutics those using it paid too little attention to the pathology of the disease treated and to diagnostics, consequently recognition of the usefulness of the method was retarded. The author says, "It is unfortunate that a method as important as electrotherapeutics should have been more or less disqualified by imperfect apparatus and improper applications and careless selection of cases in the past." He also says, "If progress in medicine is to be uniform, methods of treatment recommended by one specialty must be carried out strictly in accordance with directions, otherwise one group of observers will succeed and the other group will fail in exactly similar cases of pathological processes."

Studies on the Changes Produced by Roentgen Rays in Inflamed Connective Tissue. Alexander A. Maximow, M.D. J. Exper. Med. 37: 319, March, 1923.

THE changes produced by the x-rays in connective tissue elements are unknown but the author infers that they must be of great importance from the fact that the connective tissue is inevitably involved in all forms of roentgenotherapy. Ribbert believes that x-ray carcinoma is the result of changes in the connective tissue exposed to x rays. Fraenkel believes that the loose connective tissue is a single large endocrine system.

The topics discussed are: Material and methods; granulation tissue and the exudate layer surrounding the foreign body; changes in the blood vessels; changes in the muscles; inflammation in previously exposed connective tissue and the action of x-rays upon scar tissue.

For more than twenty years this author has made a special study of the inflammatory changes in connective tissue; in 1919 he began certain studies upon the effect of x-rays upon inflamed connective tissue and this paper is a report of that experimentation, which was done upon rabbits. The work is not yet complete.

Flat celloiden blocks with slits cut parallel in their surface were introduced into the subcutaneous loose connective tissue of the abdominal wall to induce aseptic inflammation, and the area above these was rayed once a day for a certain period. A filter of 0.5 Al was used with Gundelach or Mueller type tubes at a distance of 14 to 15 cm. Daily exposure lasted about fifteen minutes. The dose was about 12 Kienboeck's quantimetric units.

Quite a detailed histological description is given of the changes found upon examination after raying, a part of which is here quoted: "It is surprising that the results seem not to agree with the predominating views of the action of x-rays upon cells. Apart from the endothelium of the blood vessels, of all the cells present in the field of inflammation the fibroblasts are undoubtedly to be considered as the elements most highly differentiated in a specific sense. I have shown that as a rule they do not round up in inflammation and do not produce ameboid cells but remain unchanged in morphology, and through mitotic division give rise to the new connective tissue. On the other hand there can be no doubt that the lympocytes and the polyblasts are to be looked upon as relatively indifferent cells, endowed with great prospective potencies of development. Thus it might be expected that just the lymphocytes of the inflamed area would be affected in the first place by the rays, as they are in the blood forming organs, and that the fibroblasts, on the contrary, would be refractory.

"But the facts have proved that the most conspicuous and constant changes concern the fibroblasts. They are paralyzed for a long time and made unable to build up new tissue. The fibrinous exudate and the edema might perhaps also depend partly on a direct injury of the colloidal intercellular substance, partly on changes of the endothelium of the blood vessels, cells which are again to be considered as highly differentiated."

Hertwig's researches proving that the nucleus with its chromatin is the most affected of all the parts of the cell was confirmed.

Neither the inflammation stimulus alone nor the x-rays alone in the doses given were able to produce the changes noted. Only the combination of the two, in either sequence, had such result.

"The strong inhibitory and deleterious influence of x-rays on inflamed connective tissue ought to be kept in mind in the therapeutical use of this kind of energy, especially in cases of malignant tumors, in which the local connective tissue in most cases is found in a state of inflammatory irritation."

Effect of Injection of Active Deposit of Radium Emanation on Rabbits, with Special Reference to Leukocytes and Antibody Formation. Ludwig Hekoten and H. J. Corper. J. Infectious Diseases 31:305, October, 1922.

THE authors decided as a result of certain experiments that "an active deposit of radium is lethal to rabbits when given intravenously in amounts of approximately 8 to 10 millicuries per kilogram weight. In lethal amounts given intravenously the active deposit produces an initial leukocytosis with finally a marked diminution in the circulating leukocytes, mainly the polymorphnuclears. This is associated with changes in the liver, lungs, lymph glands, spleen, suprarenals and kidneys and is frequently accompanied by capillary hemorrhages. These results are similar to those Bagg obtained with an active deposit in white rats and dogs. Given intravenously, active deposits in non-lethal amounts may have a depressing effect on the formation of lysin and to a less extent on precipitin from sheep blood."

High Voltage Therapy in Treatment of Carcinoma of the Breast. Joseph Aspray, M. D. Northwest Med. 22:85, March, 1923.

THE author classifies carcinomas of the breast as (1) primary operable, (2) primary inoperable, (3) recurrent operable, (4) recurrent inoperable, (5) for prophylaxis.

The primary and recurrent inoperable may be rendered operable in a certain percentage of cases. Pre-operative and postoperative treatment is recommended in all operable cases.

Dr. Bloodgood is quoted as giving pre-operative treatment in all evidently malignant breast cases and as advising postoperative treatment after operation involving the glands. Dr. Burton J. Lee of the New York Memorial Hospital and Dr. James T. Case of Battle Creek are quoted as favoring and using pre-operative treatment.

The author writes the following conclusions: "(1) High voltage therapy is of greater advantage and benefit than the older type of therapy. (2) All cases should be carefully examined and if metastasis is found or the mass is adherent radiation should precede operation. (3) All definite malignant cases should be treated with radiation before and after operation. (4) Healing is not interfered with if operation does not follow radiation too soon, and the tendency to infection is not increased. At least four to six weeks is recommended after high voltage therapy before operating."

Pelvic Measurements by X-ray. Alfred Baker Spalding, M.D. Surg. Gynec. Obst. 35:813, December, 1922.

CHAMBERLAIN and Newell of Stanford University Hospital in 1921 published the details of a method of x-ray pelvimetry which they had developed at that hospital. This method is a simplification of that by Runge and Gruenhagen.

The distinctive points in the Chamberlain and Newell method are "a plumb-bob hanging from a lead ring under the target which is set 80 cm. above the plane of the film; second, a wire stretched across under the patient; and third, a 10 cm. rod which is placed on the body of the patient just above the symphysis."

The method is too expensive for routine use but it has been found very helpful in gauging the diameters of the outlet of the pelvis and has at times saved the patient an unnecessary Caesarean section when external measurements had seemed to indicate one necessary. Accurate diagnosis of the position of the presentation part is remarked upon as one of the boons of x-ray in obstetrics.

The x-ray department of Leland Stanford Hospital entered into a contest with the rest of the obstetrical staff (obstetricians, senior and junior staff and students) to see what method yielded most accurate measurements. It was found that certain of the pelvimeters in routine use gave erroneous measurements and that different methods of pelvimetry gave varying measurements. It was also found that sufficient argeement did not exist regarding the exact points from which measurements ought to be made.

The roentgenologist, unless he is also a trained obstetrician, cannot give a reliable prognosis from his measurements alone; he and the obstetrician should consult with each other before prognosis is agreed upon.

Hydatid Cysts of the Heart with Report of a Case. H. W. Mills, M.R.C.S., L.R.C.P., F.A.C.S. Surg. Gynec. Obst. 35:455, October, 1922.

THIS is a report of the postmortem finding of a hydatid cyst, 5 cm. in diameter, in the right ventricle of a thirty-eight year old woman.

The growth had a typical laminated cyst wall. There were no daughter cysts nor scolices but four cysts the size of a walnut were found on the inner side of the lower lobe of the right lung, the other lung being normal.

In these cases the secondary lesions of the lungs may be larger than the primary growth in the heart. A multiplicity of cysts in the lung suggests their secondary origin as does their cortical position. However, metastatic cysts of the lung may be central.

"No case of hydatid cyst of the heart has ever been diagnosed in a living subject though Cerne once rightly suspected one. The x-ray will sooner

er later wipe out this reproach." Cardiac murmurs are not usually evident. Spontaneous cure sometimes results.

The Value of the Roentgen Ray in Cardiac Diagnosis. Frank N. Wilson, M. D. *and* Forrest Merrill, M. D. Am. J. Med. Sc. 165: 340, March, 1923.

THIS detailed discussion covers 16 pages of solid text upon the following topics: Appearance of the heart on fluoroscopic examination; cardiac pulsations; effects of respiration and change in posture; the roentgen ray in the diagnosis of cardiac enlargement; variations in the size of the heart; recognition of enlargement of individual cardiac chambers; hypertrophy and dilatation, cardiac weakness; diagnosis of valve lesions.

The roentgen ray, say these authors, is an invaluable agent in the examination of the heart, provided the ray is used in conjunction with all other known methods of examination. One should neither overestimate nor expect too much of roentgen ray examination. The limitations of inspection, percussion and palpation are well known and therefore these methods seldom lead to gross error; but the roentgen ray, while it is a far more accurate method, has limitations not well known to any but the most expert and experienced in its use and in the hands of the insufficiently informed and over-enthusiastic it has frequently led to mistaken conclusions.

"We must conclude that with the standards at present in use it is impossible for the roentgenologist to diagnose with certainty grades of cardiac enlargement that are not recognized or suspected by the clinician. * * * There is need for a much more comprehensive study of the normal cardiac silhouette than has yet been attempted. In such a study all of the factors known to influence the size of the heart shadow should be included. Not only height and weight but the body surface, the sitting height, the heart rate, the age, the diameters of the chest, the angle of inclination of the long axis of the heart, and the amount of physical exertion to which the subject is accustomed should be recorded so that the influence of each may be determined. The anterior-posterior diameter of the heart and the inclination of its long diameter with reference to the axis of the body should be measured. And finally subjects should be selected with great care and should be re-examined after from two to four years so that incipient cases of heart disease might be excluded; this could easily be done in any medical school, where freshmen could be chosen as subjects and could be kept under observation until after graduation."

Van Zwaluwenburg's method of diagnosing cardiac enlargement from the cardiac silhouette by treating the silhouette as an ellipse and computing the area by multiplying the product of the large and short diameters by 0.7854 is discussed as is also another method by which enlargement is determined from calculations based on the ratio of the total transverse diameter of the heart to the internal diameter of the chest. Another method compares the total transverse diameter of the heart shadow with the average value of the same measurement in the normal subject of the same weight.

In diagnosing valve lesions it is especially emphasized that the roentgenologist should not look upon valve lesions not associated with more or less characteristic alterations of the cardiac silhouette as comparatively unimportant. He should remember that the importance does not depend solely upon the magnitude of the mechanical disturbance produced but upon the nature of the disease process to which it is due.

Neoplasms of the Larynx. Charles M. Robertson, M.D., F.A.C.S. Illinois M. J. 43:210, March, 1923.

A CONDENSED review of the literature is given and the etiology, symptoms, classification and treatment of these neoplasms is discussed.

The author has this to say of other than surgical treatment: "Diathermy has been used with more or less success, although authors vary on the end results, some claim prompt eradication of growths with happy results, while others seem to be disappointed by its use. Of the different forms of heat rays it appears to the author the most favorable of these yet used.

"X-ray is of advantage in controlling the pain in laryngeal growth, but as a treatment alone it seems to be very disappointing, as cases seem to go on in the usual way despite its use.

"Radium has many ardent admirers and I have seen tumors soften for a time under its use; later, however, there seems to be an exaggeration of the spread of the growth and it appeared to me the process was accelerated, rather than retarded and obliterated."

Importance of Indirect Roentgen Findings in Chronic Infection of the Biliary Ducts and Gall-ladder. M. P. Burnham, M. D. Am. J. Roentgenol. 10:105, February, 1923.

THE importance of indirect roentgen evidence at any stage far outweighs that of the direct evidence. The evidence may be divided into two groups: "(1) Changes of form and position seen in the first and second portions of the duodenum, and (2) variations in the normal gastric physiology."

Discussing this evidence the author says: "The first class of evidence, namely, that of change of form and relation in the first and second portions of the duodenum, and due to pressure mainly, although adhesion fixtures cannot be excluded as a cause, consists of clean-cut indentations of the duodenal bulb, crescentic deformities, usually seen on the lateral aspect of the bulb or on the inferior aspect; also irregular deformities of the bulb, not of the crescentic type, and distortion in the course of the descending duodenum amounting in many cases to very great angulation. These gall-bladder pressure deformities are, in a general way, much alike in all cases, changing as to the particular point in the duodenum at which the pressure is most prominently seen, dependent upon the pathology present in the individual case. The angulations in the course of the second portion in the duodenum are quite as characteristic as the indentations in the bulb, in our experience.

The second class of evidence, namely, that of changes in the normal gastric physiology, is most interesting, but not nearly as decisive in character as changes noted in the duodenum. It may be stated that the normal stomach accepts the liquid opaque meal, holding it in the form of a column of about equal width throughout, the pyloric sphincter closing, preventing its discharge into the intestine, and the cardiac sphincter closing, preventing regurgitation of the stomach contents into the esophagus.

"There is frequently seen, in cases of gall-bladder and bile duct infection, a narrowing in the pyloric end of the stomach produced by spasm of the wall, the stomach taking the form of a narrow caliber tube. In other cases is seen a conical-shaped pyloric section, the result of spasm, with apex at the sphincter. This spasm appears immediately upon taking a meal, and may persist for considerable periods of time. When the peristalsis is established it is noted that the waves begin far back on the curvatures and traverse the stomach slowly, often failing to reach the pyloric sphincter. At no time has the antrum a globular shape such as we see normally. This spasm of the pyloric section increases the intragastric tension and, I believe, is the cause of the sensation of fullness and distention of which patients complain."

Studies of the Mechanism of Movement of the Mucous Membrane of the Digestive Tract. Goesta Forssell, M. D., Stockholm. Am. J. Roentgenol. 10:87, February, 1923.

THE prevailing opinion that the folds of mucous membrane of the stomach are caused by the contraction of the muscular coat of the stomach is incorrect, according to Dr. Forssell who believes that the folds are due to active movement of the membrane itself.

He reached this conclusion from a study of "anatomical preparations, series of roentgenograms and photographs of the digestive tract of human beings (living)." The photographs were made possible in a case of ileal fistula, almost 3.5 by 4 cm. in size, which occurred in a fifteen year old boy. The folds of the membrane changed form and position without the exposed surface of the intestine visibly changing its size or form, "and independently of the rhythmical contractions of the muscular coat that passed over the muscular coat almost eight in a minute." Twelve pictures of the surface of this mucous membrane taken within an hour show the different phases of movement, six of these illustrations are reproduced in the original article.

The author also had the opportunity of observing "an exposed surface of a mucous membrane from the colon descendens, in the prolapse of the colon in a colostomy, and could thereby ascertain that, in general, a richer forming of the folds appeared together with an uncreased contraction of the muscular coat, but that the mucous membrane even with very high folding could freely be moved against the underlying muscular coat; that a change of the folds of the mucous membrane as to the number, position and form took place, independently of the contraction of the muscular coat, and that purely local ridges of the mucous membrane have been formed without a corresponding local contraction of the muscular coat."

Summing up the evidence of his studies he says: "It should, therefore, be without doubt that the folds of the mucous membrane, of the colon as well as those of the stomach, duodenum and small intestines are not modeled by a contraction of the muscular coat only, but by autonomous appropriate movements of the mucous membrane."

The motor force of the mucous membrane is the muscularis mucosae and "is able to displace the mucous membrane in all directions by means of transversal, longitudinal and oblique fibers."

A simultaneous contraction of the muscular coat of the stomach may aid in these specific movements of the mucous membrane but "a definite degree of contraction of the muscular coat does not produce a definite corresponding relief of the mucous membrane; on the contrary, a stage of contraction producing a certain width of the muscular tube, can be associated with a relief of the mucous membrane varying from an even surface to a very complicated folding."

A new chapter in the etiology of certain diseases of the alimentary tract will probably be written when research upon the problem is complete.

A Rare Case of Symmetrically United Proximal Epiphyses of the Second Metacarpal in a Child of Three. Dr. B. Gorynkraut. Bull. Soc. de radiol. med. de France 95:28-29, January, 1923.

A THREE year old baby born of healthy Russian parents, was presented, with a complaint of severe pain in the right wrist. There were no signs of inflammation, and the pain was strictly localized at the base of the second metacarpal. A few days later there was a cessation of pain in the right wrist but pain had developed in the left wrist.

Roentgenographic examination revealed a wedge shaped incomplete fissure in the base of each second metacarpal. The presence of an injury was definitely eliminated both by anamnesis as well as by the roentgenographic appearance. Due to lack of trauma, absence of any signs of inflammation, the symmetry of the lesion, and the rapid development and termination of the pain, the author was led to regard this as a disturbance in the process of ossification.

Normally there is only one center of ossification for the shaft of the metacarpal, and one for the distal epiphysis with the exception of the thumb where one sees the reverse, because the proximal epiphyses of all but the thumb metacarpals unite during fetal life. The author concluded that this disturbance in ossification was probably due to lack of vitamines in the mother's food during pregnancy as the parents were then living in famine stricken Russia.

The possibilities of myxedema and mongolism in which such persistence of epiphyses has been described, had to be excluded in this case. Nor were there found any abnormalities in the feet.

A. M. PFEFFER.

Stimulative Roentgen Ray Doses in Alopecia Areata. Dr. Thedering. Deutsch. med. Wchnschr. 49:89-90, January 19, 1923.

THE author is inclined to join that group of investigators which regards alopecia areata and seborrhoea as caused by some microbic agent. Alopecia areata is certainly curable, as the hair follicle is not dead, but only hardened and in a condition of paralysis. In the long standing cases the follicles may have undergone complete atrophy of disuse and the condition is incurable, but in the early cases a sufficiently irritative or stimulative dose will reawaken them to activity.

The three conditions for curability of alopecia areata are:

(1) The follicles must be preserved.

(2) The stimulation must be sufficiently strong, and

(3) Must reach deeply enough.

The inefficiency of the various chemical agents as chrysarobin, etc., is due to their incapacity to penetrate to the follicle. The splendid results obtained in this stubborn condition by radiation with ultraviolet rays are well known. Nogelschmidt had 200 cases, Bering had 100.

Besides that ultraviolet radiation takes often too much time, it is only applicable in cases of easy accessibility, such as in men with short cropped hair, but in women where there is a mass of hair, the lesions cannot be well reached for exposure to ultraviolet rays without much time-robbing preparation. The ultraviolet radiation must be frequently repeated, and at each repetition the time of exposure lengthened on account of the pigment deposit in the skin. Cases of relapse are too frequent in ultraviolet treatment, because the underlying cause, the seborrhoea, has not been affected.

The author found that a radiation on the bearded region of 11 X with ½ mm. Al filter produced increased growth in the first week, stationary growth the second week, and loss of hair in the third week. From this fact it is evident that a fraction of that dose will be stimulative only.

The author found that dose to correspond to the radiation of 1 to 2 X with ½ to 2 mm. Al filtration. As the effect of this dose passes after two weeks, it may be repeated every two weeks until the hair begins to grow again. This dose is given each time in several places, so that the whole scalp is well covered. The seborrhea is treated at the same time during the radiation, which is generalized.

There is no fear of either temporary or permanent epilation, because the depilitory dose is 10 to 12 X while this stimulation dose requires only 1 to 2 X.

The author has successfully used this treatment in more than 100 cases within the last five years.

A. M. PFEFFER.

Grashey—Atlas Typischer Roentgenbilder J. F. Lehmann, Verlag, Muenchen, 1923, Price $4.00.

AS EXPLAINED by the title this book is an atlas of typical roentgenograms of normal individuals. The author, who is one of the members of the editorial staff of the Journal of Radiology, is so well known from his long association with the University of Muenich that he needs no introduction. The book is one which should find a place in the reference library of every radiologist. This issue is the fourth edition of the book. It has been modernized and a number of additions have been made including a chapter by Herr Dr. Voltz on the physics and technique of x-ray production.

The reproductions of roentgenograms are accompanied by a key in black and white line drawings making the interpretation of the x-ray plates exceedingly clear and vivid. Wherever helpful, anatomical wash drawings are used to make the interpretation of the x-ray plate more certain.

There is an abundance of material giving the correct positions when making roentgenograms of various parts of the body. Drawings with angles plainly marked help one to visualize the part being examined. This section will be found especially helpful to the technician as well as the less experienced radiologist.

A table of contents coupled with an alphabetical index, makes it easy to refer to any information desired.

A. F. TYLER.

The JOURNAL OF RADIOLOGY
Omaha, Nebraska

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A Study of Lung Abscess by Serial Radiographic Examination*

(From the X-Ray Department of City Hospitals Nos. 1 and 2)

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St. Louis

SERIAL radiographic examinations have proved to be of great value in studying the progress of all pathological lesions, but in no condition have they proved of greater advantage than in acute inflammatory conditions of the lungs. Because serial studies have been so helpful to the better understanding of the cause and progress of the various pneumonias [1,2] it was thought that a similar method might be of advantage in the study of lung abscesses, hence this study, which is based on the radiographic examination of 45 cases of lung abscess occurring at City Hospitals No. 1 and No. 2, and their allied dispensaries during the past three and one-half years.

Before passing to the description of the various radiographic types of abscess encountered in this group, let us define just what is meant by "lung abscess" and just what type of cases should come under consideration in this discussion. By "lung abscess" we mean an acute inflammatory disintegration of lung tissue occurring within the lung, involving the lung substance itself, as a result of the invasion of pyogenic microorganisms. This excludes abscesses due to the tubercle bacillus and all suppurative processes of the pleural cavity, such as empyema, general or localized, or small pus collections occurring in association with serofibrinous plastic pleurisy. Such a condition presupposes an area of pneumonic consolidation in the lung as nature's effort to erect a barrier to the invading organism, and in this respect all abscesses may be considered to be postpneumonic consolidations thrown out as nature's effort to limit a pyogenic infection, similar to a like process occurring elsewhere in the body. Let us confine the use of the word "pneumonia" to the acute consolidations of the lung commonly understood by this term—namely, bronchopneumonia and lobar pneumonia.

With this conception of the words, "lung abscess" and "pneumonia," let us endeavor by the aid of serial roentgenographic examinations to investigate the characteristics and the progress of the disease as it appears in its different clinical forms. To be of the greatest value for such a study, the pathological lesion must be observed from its inception and its progress noted. Many of our cases came under observation when the condition was well established and the lesion far advanced. A considerable number, however, have come under observation at the very beginning of the disease, so that a complete record of the condition is available.

Clinically, lung abscesses are known to occur:

(1) Postoperatively, especially following operations on the upper respiratory tract.

(2) After the aspiration of infected material.

(3) After exposure to cold.

(4) Following influenza (not the epidemic type).

(5) Idiopathic, without apparent cause.

(6) As a sequel in lobar pneumonia.

(7) As a result of bronchopneumonia.

(8) In septicemia from septic thombi or following septic pneumonia.

(9) From lymphatic extension or regional drainage.

(10) From direct introduction of infected material into the interstitial tissue of the lung as a result of destruction of the esophageal wall by carcinoma.

Six of the cases of this series occurred postoperatively, two followed

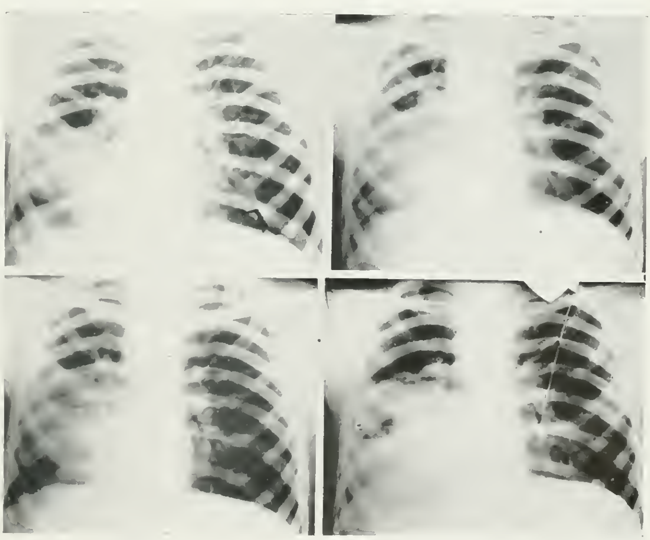


Fig. 1—Abscess of the lung following six days after tonsillectomy under ether anesthesia. (a) The process began as a consolidation in the hilus region. (b) The consolidation increased rapidly in size and progressed toward the periphery. (c) Early in the course of the disease a rarefied area appeared in the midst of the consolidation. (d) The process did not go on to spontaneous healing, but resulted ultimately in a chronic interstitial pneumonia and multiple abscess formation.

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 4, 1922.

tonsillectomy, one heriotomy, one appendectomy, one cholecystectomy, and one an operation for ruptured duodenal ulcer. The first case (Fig. 1), which we shall study as representative of this group, followed tonsillectomy. Six days after the tonsil operation, under ether anesthesia, attention was directed to the chest, and radiographic examination made at that time disclosed a consolidation confined to the hilus region. Subsequent radiograms taken at daily intervals revealed the rapid increase in the size of the consolidated area and indicated its progression toward the periphery. Shortly after the onset a rarefied area was seen in the midst of the consolidation, establishing the diagnosis of abscess formation. Such a rarefied area may be seen at a single examination and not be detected on subsequent plates. It may be seen regardless of whether the abscess cavity has ruptured into a bronchus or not. In this instance it could be detected before rupture had occurred. When about one week later rupture of the abscess and evacuation of the pus through a bronchus did occur, the inflammatory consolidation subsided rapidly. The process did not go on to spontaneous healing, however, and considerable evidence of a persistence of the lesion was left on the radiogram. Subsequent exacerbations left the entire lower portion of the lung filled with multiple abscess cavities.

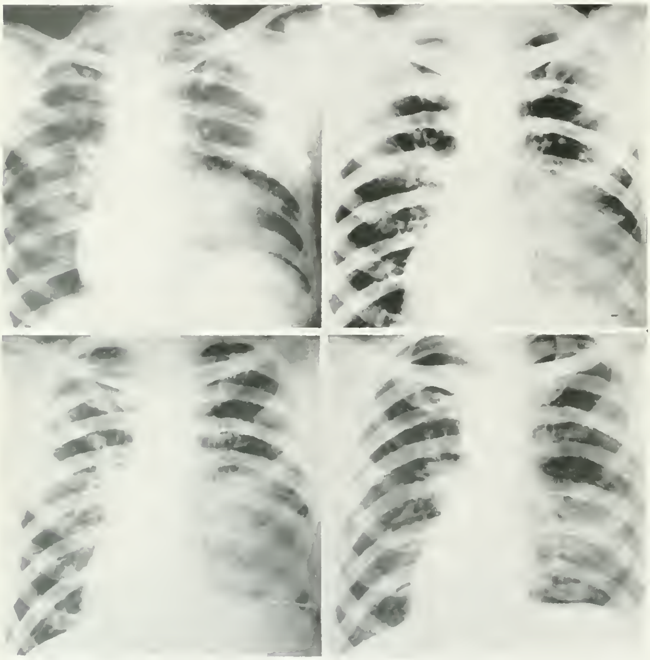


Fig. 2—Abscess of the lung following six weeks after appendectomy under ether anesthesia. (a) In this case, likewise, the original consolidation was in the hilus region. (b) Increase in size of the consolidated area followed (c) A rarefied area (abscess cavity) soon appeared within the consolidation. (d) Rupture and evacuation of the pus through a bronchus resulted in prompt and complete recovery.

One other case of lung abscess following tonsillectomy began in precisely the same manner and ran the same radiological course. Rupture of the abscess and evacuation of the pus occurred early in the course of the disease and the condition resulted in a complete spontaneous recovery.

The four other cases included in this group followed abdominal operations, done under ether anesthesia; one for appendectomy, one for heriotomy, one for cholecystectomy, and one for a perforating duodenal ulcer.

The following case is representative of this group of postoperative abscesses (Fig. 2). The patient was admitted to the hospital with acute appendicitis and an appendectomy was performed under ether anesthesia. Postoperative convalescence was uneventful for six weeks, when a high temperature, together with pain in the chest, prompted examination of the lungs. A consolidation limited to the hilus region was encountered, which on early examination showed extension of the consolidation to the periphery. Early in the course of the disease a rarefied area was noted within the consolidated area. Spontaneous evacuation of the pus was followed by complete rapid recovery, the entire process requiring only about five weeks. In neither of the other two cases of this group was there spontaneous cure. One came on a few days after operation, one other was discovered ten months after operation for hernia.

From the similarity of the radiographic findings in these cases and the widely varying character of the operative procedure, it seems most probable that the only common factor involved in all of the cases (namely ether anesthesia) must be in some way responsible for, or concerned in the production of the condition. It is possible that the condition might be due to aspiration of foreign material while under anesthesia and the radiographic findings would seem to point to an invasion of the lung by way of the air passages. That some other factor is also concerned in the production of the condition there seems little doubt, in so far as many patients who aspirate large quantities of infected material never develop lung abscess, whereas some in whom no such history

Fig 3—Acute lung abscess probably resulting from aspiration of infectious material from a co-existing tuberculous lesion. (a) As in the previous cases the original consolidation was seen in the hilus region. (b) This rapidly increased in size and soon a definite abscess cavity was seen in its midst.

is obtainable develop the condition without apparent cause. Lowering the resistance of the bronchial mucous membrane, either locally by anesthesia, by repeated aspiration of infectious material, etc., or generally by the intercurrence of some general disease such as diabetes, carcinoma, etc., may be the factor which provides a fertile field for the bacterial invasion.

On close observation of the history of our cases, not a single one was encountered in which a definite history of aspiration of foreign material was followed immediately by abscess formation. One case was encountered in a patient suffering from tuberculosis of the opposite lung, in which acute lung abscess occurred probably from the aspiration of infectious material into the normal lung. (Fig. 3). The onset of the disease, with a definite hilus consolidation, and its course are very similar to those described under postoperative abscesses, and it is probable that they both represent the invasion of the lung by the air passages The matter of dosage may be considered as a contributing factor—a single inoculation of infectious material being thrown off, but, as was evidently the case in this instance, the repeated aspiration of infectious material from the co-existing pathological condition in the opposite lung resulted ultimately in the patient succumbing to the infection. It is not, however, exactly clear why lung abscess should follow six weeks after operation in one case and ten months after operation in another if aspiration of infectious material while under ether were the sole cause.

That exposure to cold may be the only demonstrable factor in the production of lung abscess is evidenced by the following case. This patient, in apparently good health, boarded a freight train a hundred miles or so away from St. Louis, with the intention of stealing a ride to this destination. While on the train he was exposed for several hours to a piercing cold rain, which drenched him to the skin. On his arrival in St Louis he had to be removed at once to the hospital and an x-ray examination (Fig. 4) made the next morning disclosed a consolidated area in the hilus region, which, on subsequent examination, rapidly extended to the periphery. That the process was primarily a lung abscess is evidenced by the fact that on the sixth day after the onset a definite rupture occurred and pus was evacuated in large quantities. The very foul odor of his breath suggested a gangrenous process and a rather refractory hiccough lead to the suspicion of subphrenic involvement. Pneumoperitoneum examination, however, disclosed the subphrenic space free from involvement. The condition ended in spontaneous recovery. The rapid onset of consolidation after exposure to cold would render the possibility of an intercurrent influenza infection unlikely, and it is quite probable that in this instance the exposure to cold was all that was necessary to bring about the condition favorable for abscess formation. That this is a possibility, however, must not be overlooked.

Two cases included in this series followed clinically typical cases of influenza (not the epidemic type) (Fig. 5). Plates taken during the influenza stage showed nothing other than the increase in peribronchial markings and the increase in hilus shadows ordinarily found in this condition[5]. Apparently without intercurrent pneumonia, or, at least, very soon after the onset

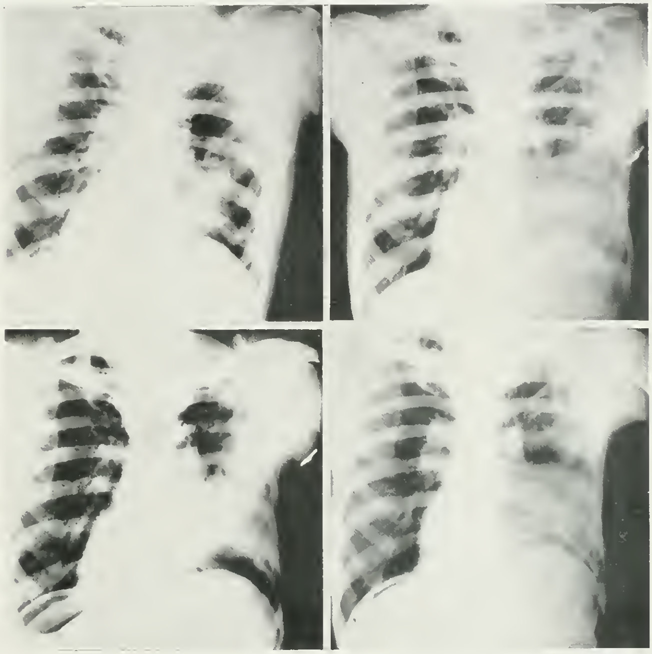


Fig. 4—Lung abscess following exposure to cold. Patient was exposed to cold and wet weather for several hours previous to his illness. (a) Radiographic examination made within twenty-four hours revealed a consolidation confined to the hilus region. (b) This rapidly spread towards the periphery until it involved the entire lower portion of the lung. (c) A persistent hiccough and a foul odor to the breath suggested gangrene and subphrenic involvement. Pneumoperitoneum examination revealed the subphrenic space clear. (d) Evacuation of pus through a bronchus was followed by prompt spontaneous cure.

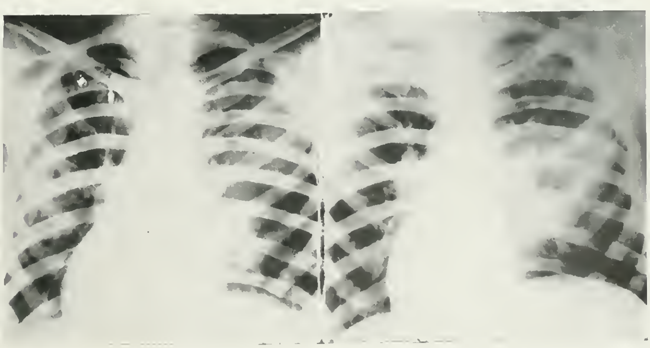


Fig. 5—Abscess of the lung following three weeks after an attack of influenza (not epidemic type). (a) During the influenza stage nothing beyond the increase in peribronchial markings and hilus shadows customary with influenza was noted. (b) After a latent period of several weeks abscess formation began and in a very short time a definite abscess was established.

of the pneumonic consolidation indications of abscess formation were present.

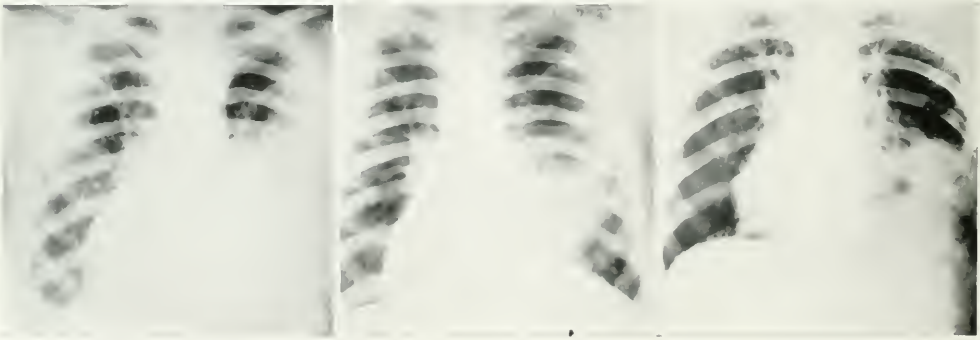
In the beginning a leukopenia was present, but upon the formation of an abscess this gave place to a marked leukocytosis. The onset and course, as will be observed, is very similar to that described in the previous types; it started as a hilus consolidation and rapidly progressed to the periphery with subsequent abscess formation.

That some of the cases of so-called insidious or idiopathic origin may be sequelae of an influenza infection is also quite possible. Eight cases in our series were of this idiopathic type and are well represented by the following case (Fig. 6). Without apparent cause the patient was taken sick with pain in the chest, dyspnea and fever, chillly sensations and chills, followed by profuse sweating. Radiographic examination made at this time revealed a distinct hilus consolidation.

Similar to the preceding cases which followed influenza infection, the acute consolidation was seen in this instance to appear first in the hilus region. There was this difference, however, that in the cases following influenza infection a period of time elapsed during which no consolidated area was demonstrable in the chest, while in this case of insidious origin no such interval was noted, the hilus consolidation appearing simultaneously with the onset of the illness. Radiographic examinations made at daily intervals revealed the enlargement of the hilus shadow and its progression outwards, and on the third day disclosed an area of rarefaction within the consolidation which established at once the character of the lesion. Subsequent radiographs revealed the extension of the consolidation until it occupied the entire lower portion of the chest simulating at one examination a lobar pneumonia and at the next a large pleural effusion, although the subsequent cause of the disease disclosed that no fluid was ever present in the free pleural cavity. At this stage rupture of the abscess occurred and the pus was evacuated through a bronchus. Rapid resolution of the process resulted and within two weeks the consolidated area had again receded to the size encountered at first examination. While such a rapid recession is a very favorable sign for an ultimate spontaneous recovery, yet the subsequent history of this patient should be a warning that apparent clinical cure is not always absolute cure. This patient, at this stage of the disease, felt so well and was so much relieved that he demanded his discharge and was dismissed. In about one month the patient "suffered a relapse" and was again admitted to the hospital. Roentgenographic examination at that time revealed multiple abscesses in the lower lobe with interstitial pneumonia, a condition far worse than at any other time of the disease.

A brief review of all of the groups here represented will disclose a striking similarity. That they all represent invasion of the lung by way of the bronchi seems quite evident from the radiological evidence. All start as a hilus consolidation, and progress peripherally and without distinction to lobar involvement, often showing a rarefied area of tissue destruction early in the

Fig 6—Idiopathic type of lung abscess. (a) Without apparent cause or reason the patient was seized with a chill, high temperature and pain in the chest. Radiographic examination at this time revealed a consolidation in the hilus region. (b) Within three days a definite abscess cavity was seen in the midst of the consolidation. (c) The consolidation increased rapidly in size. It is noteworthy that the abscess cavity previously seen was no longer discernible.



(d) Within less than one week the consolidation had involved the entire lower lobe, giving in the radiograph the appearance of free fluid in the pleural cavity. (e) That no fluid was present in the pleural cavity, however, is evidenced by the rapid recession of the inflammatory consolidation following evacuation through a bronchus. This radiograph representing a size scarcely larger than the original consolidation was again attained after less than two weeks. (f) The patient was readmitted to the hospital one month later with an acute exacerbation which resulted in interstitial fibrosis and multiple cavity formation.

Fig. 7—Lung abscess following lobar pneumonia. (a) Right upper lobar pneumonia showing consolidation confined to this lobe. (b) A partial resolution of the pneumonic consolidation has taken place, but a large abscess cavity is seen in the remaining consolidation. (c) Rupture of the abscess into the pleural cavity occurred, causing a general empyema. A small amount of fluid can be seen in the lower chest. The cavity previously present in the upper lobe disappeared completely within a few days with the resolution of the remaining pneumonic consolidation.

disease. At this stage rupture of the abscess and evacuation of the pus into the bronchus may occur or rupture may occur into the pleural cavity and empyema result. They may result in spontaneous cure or may require surgical intervention.

The next class of cases to come under consideration may properly be considered as being respiratory in origin also; namely, those occurring after lobar and bronchopneumonia. They vary in this respect, however, that they are secondary to a previous consolidation within the lung. The manner of onset of abscess formation varies somewhat in lobar and bronchopneumonia. In lobar pneumonia the consolidation characteristic of the disease when first encountered is limited to one or more lobes. The disease progresses and either the temperature falls with crisis, only to be followed shortly after by another rise, or, the temperature may never fall by crisis, but may gradually assume a septic form. In either event the consolidated area persists at least in its central portion and later an abscess cavity appears in its midst. When once established such an abscess cavity progresses much the same as the other forms previously described. There may be rupture into a bronchus with discharge of the pus, or rupture into the pleural cavity with empyema formation may occur; spontaneous recovery may result or the process may pass into a chronic state with formation of numerous abscesses and an interstitial pneumonia which can only be cured by surgical intervention (Fig. 7). In the case illustrative of this group a right upper lobar pneumonia was followed by an abscess. The definite outline of the abscess cavity can be seen. Rupture of the abscess occurred into the general pleural cavity causing an empyema. It is noteworthy that rupture of the abscess in this instance was followed by complete resolution of the remaining inflammatory process.

Seven cases following lobar pneumonia occurred in this series.

In bronchopneumonia the small peribronchial infiltrations become necrotic and form small abscesses. These coalesce and form larger abscesses in the mid-portion of the lung. Their appearance is quite characteristic. Six cases following bronchopneumonia were encountered in this series (Fig. 8).

The next class of cases which present themselves for our consideration are those of hematogenous origin. Two of our cases were of this type and both occurred during septicemia, which followed incomplete abortion. Curettage was performed in one case, but in neither was a general anesthetic administered. While neither of these cases came under observation at an early enough date to permit an accurate statement as to the definite course of the disease, it can be said that in a general way these abscesses start as a haze overlying the entire lower porton of the lung, much the same as septic pneumonia (Fig. 9).

Lung abscess in the regional lymphatics may result from the drainage of a septic process, even though the original process itself may not result in suppuration. Such a condition is seen where abscesses of the lung follow infected conditions in the esophagus—infected carcinomatous ulcer (Fig. 10). In the case which I have chosen to illustrate this group there was a suppuration of a hilus lymph node following a pneumonic process in the lung. The hilus abscess remained long after the primary pneumonic consolidation which caused it had resolved. Where abscess formation is suspected in the hilus region the lateral view is of greatest aid in detecting its presence. Note the thickening of the inter-lobar pleura incident to the infectious process. Three cases were of this type.

The last type of lung abscess which will be discussed is that caused by a

Fig. 8—Abscess of the lung following bronchopneumonia usually represents the coalescence of small abscesses formed from small necrotic areas in the lung.

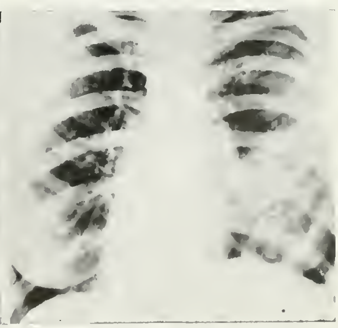


Fig 9—Lung abscess following septic abortion. No anesthetic was given and the process was probably hematogenous in origin.

direct extension of infectious material into the interstitial tissues of the lung, due to rupture of the esophagus by malignancy, foreign body or other cause (Fig. 11). In the case illustrative of this group there was complete destruction of the esophagus by carcinoma, and a discharge of infected food material occurred directly into the interstitial tissue of the lung and formed a large abscess. It is noteworthy that a barium meal filling the cavity in this way was never coughed up through the bronchi, but was expelled by vomiting and regurgitation. The patient lived for three months in this condition with comparatively little discomfort. This is the only case of this type which occurred in our experience. The barium filled cavity was of great importance in the localization of the cavity and illustrates the practical value of this method recommended by Stewart and Lynah[4] after bronchoscopic injection. In eight of our cases the history was so indecisive that classification was impossible.

A brief analysis of the 45 cases here outlined might be of interest. With the exception of the three upper lobe cases, two bronchopneumonia cases, one postoperative case and one aspirative case, all of our patients had involvement of the lower right lung. No particular type of involvement showed any special predisposition to spontaneous cure. Clinically, a patient may appear completely cured, while radiographic examination may reveal a remaining pathology which as long as it is present represents potentially a grave condition. This has been well shown by Wessler[5] who illustrates an instance in which an almost insignificant appearing remnant of pathology in the chest resulted in a short time in an extension of the process which involved the entire lower lung with multiple abscesses. Our experience in a number of cases has been in accord with this examination. Any remaining pathological process is a potential factor for the rapid reinfection of the remaining lung.

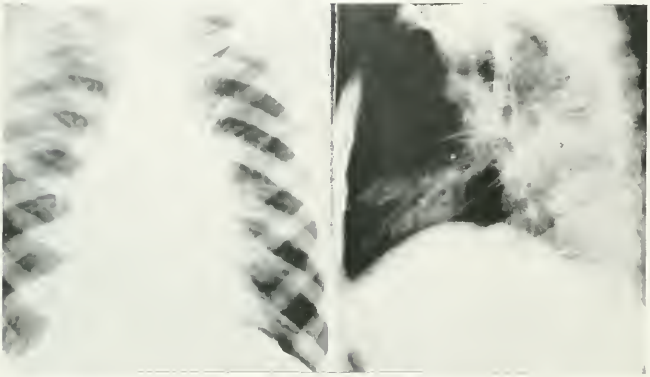


Fig 10—Lung abscess due to suppuration of a hilus lymph node following drainage of a pneumonic process in the lung. (a) In the anterior view nothing suspicious of abscess can be seen. (b) But in the lateral view the definite abscess can be made out. Note the thickening of the interlobar pleura mapping out the confines of the lobes.

Fig. 11—Lung abscess due to the direct projection of infected food material into the interstitial tissues of the lung, as a result of the destruction of the esophageal wall from carcinoma. (a) Showing the destruction of the esophageal wall from carcinoma. (b) Showing the large area of consolidation in the lung with the large barium filled cavity in its midst.

Summary

In general, lung abscesses may be said to invade the lung first by the respiratory system, either as a primary process following some condition in which the local or general resistance is lowered, or following a lobar or bronchopneumonia; second, by the blood stream in association with a septic process elsewhere in the body; third, by invasion through the lymphatics and suppuration of the regional lymph nodes due to drainage of some septic process; fourth, by direct extension from the interjection of infected material into the interstitial tissues of the lung as a result of destruction of the esophageal wall.

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Studies of the Effect of X-Rays on Glandular Activity*

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Chicago

PART I.

General Consideration of Biological Principles

WHEN a cell is acted upon by some outside influence it may be affected in one of four ways: It may be stimulated, depressed, irritated or destroyed. Factors which enhance the activity of an organ stimulate it, and those which decrease the activity of an organ depress it. Factors which cause a change in the nutrition and growth of a cell are said to irritate it. [1, 2]

Stimulation results in a quantitative increment in the specialized function of an organ, for example, in the gastric glands an increase in the formation of gastric juice, or in the spinal cord an increase in the reflex excitability. Following excessive or prolonged stimulation, the activity of an organ in many cases becomes depressed and may lose all of its functional activity (paralysis), which is more true for muscular and nervous activity than for glandular activity. [3] Fatigue and depression are then physiologically analogous so far as the end result is concerned, although they may be of a different cause. However, a fatigued organ as a rule recovers rapidly, while a depressed organ does not recover until the depressant or toxic substance is neutralized or eliminated. A fatigued or depressed organ may be functionally dead from excessive stimulation and then recover completely its normal functional activity, if death of the organism itself does not occur.

It is claimed by some authorities (Arndt-Schulz Law) "that depression is invariably preceded by stimulation, and that stimulation sufficiently prolonged invariably leads to depression and paralysis." Such a statement Cushney[1] claims is too absolute and he cites the well known example of the action of atropin on the cardiac vagus nerve endings, which is always depressant. The action of curare and of morphine on the cord are also good examples. So we cannot always say that a factor which in large doses depresses will in small doses stimulate. [4, 5, 6, 7]

*—Read at the Midyear Meeting of the Radiological Society of North America, St. Louis, May 19, 1922. A preliminary report of this work was made before the Radiological Society of North America, at Chicago, December, 1922.

While a stimulant causes a quantitative increase in specialized function, an irritant leads to a change in nutrition and growth. Stimulation is observed and studied in highly specialized cells, such as are found in the heart, nervous system and secretory glands, while irritation may be observed in all tissues and "is the commonest change caused by drugs" and other factors in the less specialized forms of tissue, such as connective tissues and ordinary epithelia. [1] Recovery can occur following excessive stimulation, but excessive irritation results in necrobiosis and cytolysis. For example, a muscle can be stimulated with an electrical current until it is paralyzed and it will soon recover, but let it be irritated with some chemical irritant such as ammonia vapor or a strong sodium chloride solution until it no longer responds and it will not recover. In the frog strychnin will first stimulate the cells of the spinal cord and then completely paralyze them and recovery will occur in a few days when the strychnin is eliminated. In contrast a small amount of an irritating substance injected subcutaneously causes a vasodilation, transudation, proliferation and fibrosis, a large amount injected to make the irritation intense causes necrobiosis, and an abscess results. The cells that were killed cannot recover, but their places are taken by cells produced as a result of the irritant where it was less concentrated and the less intense irritation caused proliferation of cells. We are aware that cantharides, which is an irritant, when administered internally, causes a diuresis, but as to whether this action is to be interpreted as meaning a stimulation of the secretory activity of the kidney is a highly debatable question.

So we are of the opinion that stimulation and irritation should not be considered as identical terms and applied synonymously when speaking of physiological reactions to external factors.

If the x-ray has an irritant action it will cause a change in the nutrition and growth of cells rather than affect directly specialized functions. It will affect more readily connective tissues, ordinary epithelial and embryonic cells. In small amounts, the x-ray, if it is an irritant, should stimulate the growth of connective and epithelial tissue cells and embryonic cells and not affect so readily cells like those in the heart, the nervous system and the secretory glands; in large amounts it will destroy. If the x-ray has a stimulating action it should produce directly such effects as augmentation or inhibition of the heart, facilitation in the reflex arc and an increase in the secretory response of the secretory glands.

When such a distinction is made between stimulation, depression and irritation and when we call to mind the action of x-rays on tissues (x-ray burn and x-ray cancer), and the special sensitiveness of tumor cells, embryonic and germinal cells to x-ray, we are inclined to be skeptical concerning the accuracy of the term "stimulative action of x-rays".

If it is granted that the primary effect of x-ray is irritation the following question arises: May not a possible improvement in the nutrition and growth of a gland cell produced by mild irritation lead secondarily to an increase in the secretory activity of the cell? In the first place, it is a well recognized biological principle that a specialized cell cannot grow and perform a specialized function at the same time. Also, hyperplasia does not necessarily mean hypersecretion. Also, if a gland cell is functioning normally, it necessarily follows that its nourishment is normal and an improvement in its nourishment then would be of no physiological value. But, on the other hand, if a gland cell is not functioning normally, due to some disturbance of its nourishment, it might be possible to improve the nourishment of the cell by a "mildly irritant dose of x-ray." But, it is therapeutically obvious that such an improvement might have no practical or permanent effect unless the cause of the abnormal functioning of the cell is removed.

Theoretical discussion and generalization concerning the possible action of x-rays on glandular activity, however interesting, is fruitless unless supported by well controlled and thorough experimentation. Well controlled and thorough experimentation is especially indicated at this time on this problem because of its great physiological and therapeutic significance. We believe that we cannot emphasize too strongly the appeal that the experimentation be well controlled and interpretations and conclusions made with caution, for fear that this field of radiotherapy will be reduced to the same state as organotherapy in endocrinology.

A Critical Review of the Literature

Adrenals: The adrenals have been subjected to the action of x-rays in cases of hypertension for the reduction

of the blood pressure and in cases of diabetes to reduce the hyperglycemia and glycosuria.

Quadrone [8], Sergent and Cottenot [9] and Zimmer and Cottenot [10] report a fall in blood pressure of from 10 to 70 mm. Hg following rather intensive radiation of the adrenals. Groedel [11] and Levy-Dorn and Weinstein [12] report no change in blood pressure following radiation of the adrenals. Stephan [5] irradiated the kidney region in a case of vasomotor paresis, hypotension and anuria, administering ten per cent of an erythema dose, and he reports that the blood pressure was raised to 130 mm. Hg. Levy-Dorn and Weinstein [12] failed to confirm Stephan and they suggest that the results of the various authors may be explained by psychic influences and lack of properly controlled experiments.

From the recent extensive work of Stewart and Rogoff [13] on the adrenals we doubt that blood pressure could be raised by irradiation of the adrenals with small doses of x-ray, because the resulting liberation of epinephrin, if it occured, would not be sufficient to cause such a rise in blood pressure as reported by Stephan. We also doubt that blood pressure was lowered as a result of the irradiation as reported by two of the above authors because such a result would be fatal, since a fall in blood pressure occurs only secondary to asthenia following complete adrenalectomy, which results in death in higher mammals. Further, Stewart and Rogoff have shown that in 20 per cent of rabbits operated the entire adrenal tissue can be removed, due to accessory adrenal cortical tissue, without any alteration of their blood pressure or disturbance of their normal state of well being. This demonstrates that the adrenals are not directly related to blood pressure and the medulla, which produces epinephrin, is not necessary for life and good health.

Eisler and Hirsch [14] after killing rats by raying their adrenals with from 150 to 200 Kienboeck units, studied the epinephrine content of their adrenals by the blood pressure method and found it reduced. Such a finding is not surprising, in view of the histological findings of Decastello [15], Zimmer and Cottenot, [10, 16] and most recently Grabfield and Squier [17] following intensive irradiation of the adrenals. These investigators report hemorrhages in the cortex and medulla, cell destruction and localized round cell infiltration in the cortex.

Dresel, [18] working on the basis of the Falta-Rudiger theory of diabetes, irradiated the adrenals of three diabetic patients, intensively, to suppress their action on the liver (according to the theory) and reports a reduction in the blood and urine sugar. He says, however, that he is not able to draw any conclusions from the observations on his three patients. Zimmer and Cottenot [10] report a case of diabetes in which the adrenals were intensively irradiated to reduce blood pressure and the glycosuria was increased. It is, it seems to us, impossible to radiate the adrenals without including some of the pancreas. But Dresel used rather intensive treatment, and, therefore, one cannot claim that the pancreas was stimulated in his cases.

Stomach: Regaud, Mozier and Lacassagne [19] report that the glands of the fundic portion of the stomach are highly sensitive to the effects of radiation, the parietal cells being less sensitive than the chief cells. Winternitz [20] reports that radium, even in relatively large doses in radio-active water (4000 Mache-Einheit to 400,000 Volt-Abfalleinheiten) has no influence on gastric secretion. Bruegel, [21] with relatively intense irradiation of the stomach in cases of hyperacidity, reports a reduction of the acidity of the gastric secretion, but in cases of hypoacidity and anacidity he was unable to augment the acid values. He does not report the "Reizdosen" used. Szego and Rother [22] report that only when using a dose greater than an erythema dose were they able to observe evidence of irritation which was followed by depression of gastric secretion. They have not published their data or protocols. Wilms [23] reports the satisfactory use of x-rays for the reduction of gastric acidity. Stephan [5] reports improvement in a case of achylia gastrica when the stomach was irradiated with a sub-erythema dose. Bryan and Dormody [24] report two cases of hyperacidity in which the patients show almost an immediate reduction in gastric acidity following 25 to 35 ma. min., 80 kv. at te inches. This dose was administered from three to four times within one month.

So the literature presents ample evidence to prove that the acidity of gastric secretion can be reduced with fairly intensive irradiation of the stomach. Whether or not such a procedure is good therapeutics from the standpoint of the stomach is a question for future experimentation to answer.

The evidence pertaining to increasing the acidity of gastric secretion in cases of hypoacidity and anacidity is very meager and highly questionable so far as its significance is concerned.

Kidneys: Much work has been done to determine what is the effect of x-rays on the kidneys. A large group of investigators [25-31] have found evidence of "x-ray nephritis" after intensive radiation. Other workers [32, 33, 34] claim that the kidney is very resistant to x-rays and that there is no such clinical entity as "x-ray nephritis." More recently McQuarrie and Whipple [35] report negative results on the production of x-ray nephritis and conclude that "moderate doses of x-rays given repeatedly over considerable periods of time have no influence on renal function or renal structure" and that "large doses of x-rays given directly over the kidney may cause a slight but distinct lowering of renal function which lasts a few days" without "any corresponding histological change."

Stephan [5] claims to have cured anuria and to have caused diuresis in twenty-four hours in three cases of nephritis by using one-sixth to one-seventh of an erythema dose. Petersen and Saelhof [36] report stimulation of renal activity following a small dose of x-rays in a few dogs under very violent experimental injury of the kidney. These cases and experiments, we are of the opinion, are barely suggestive and are not at all convincing.

Pancreas: Ascoli and Faginoli [37] treated three cases of diabetes by irradiation of the pancreas. Results were negative. Zimmer and Cottenot [10] report increase in the glycosuria in a case of diabetes after intensive irradiation of the adrenal region. Dresel [18] reports a decrease in the glycosuria and hyperglycemia in three cases of diabetes after rather intensive irradiation of the adrenal region, but states that his results are not conclusive. Falta [38] says that the general metabolism may be stimulated and glycosuria of a diabetic patient increased when treated with radium emanations. Stephan [10] treated two cases of diabetes with sub-erythema doses of x-ray and reports an improvement in their condition. Both of his patients, however, were on a restricted carbohydrate diet. Petersen and Saelhof [39] irradiated the pancreas region of five partially depancreatized dogs (diabetes levis), using 6 in. spark, 3 mm. Al, 5 ma., 10 in. focal distance, time, ten minutes, and report a more or less transient improvement in the glycosuria and hyperglycemia.

Since both of Stephan's cases were on a restricted carbohydrate diet and since the improvement reported is not marked, we are not inclined to view his results enthusiastically. And, since Jensen and Carlson [40] state from their physiological studies of partially depancreatized dogs that "one cannot predict the metabolic course of any one animal deprived of approximately seven-eighths of the pancreas," and that the question of their metabolic course on restricted carbohydrate diet "can be settled by the statistical method only,

using a great many animals for the work," and since Peterson and Saelhof report no control animals and worked on only a few animals, we are of the opinion that their results do not prove that small doses of x-rays stimulate the functioning of the pancreatic remnant.

Hypophysis: Stettner [41] reports two patients afflicted with dwarfism in which irradiation of the hypophysis with sub-erythema doses caused an increased growth in the skeleton, equal to that of two and one-half years, within a period of from 86 to 138 days. In one case he also irradiated the parotid with sub-erythema doses because of chronic parotitis. The dwarfism in the second case was complicated by epulis, for which operation was performed, and status lymphaticus. The x-rays in this second case were administered in the left cervical region and the author states that some of the x-rays probably struck the hypophysis. Fraenkel [42] irradiated the hypophysis in osteomalacia with small doses of x-ray and secured good results. Ascoli and Faginoli [37] irradiated the hypophysis in one case of dystrophia adiposo genitalis, in one case of scleroderma and in five cases of asthma and obtained gratifying results from small doses of x-ray.

Thymus: The action of x-ray on the persistent thymus is well known and established. Fraenkel [42] irradiated the thymus, with small doses of x-ray, in a case of osteomalacia. Brock [43] reports improvement in psoriasis by irradiation of the thymus with small doses of x-ray.

Gonads: The destructive action of x-ray on the germinal epithelium has been known for some time and is frequently used therapeutically. Fraenkel [42] has irradiated the ovaries with small doses of x-rays in certain forms of dysmenorrhea and amenorrhea with improvement in the condition of the patient.

Spleen: The destructive action of x-rays on the cells of the spleen is well known.

Stephan [44, 45] offers evidence which he interprets as demonstrating that deep roentgenotherapy applied to the spleen stimulates the spleen specifically to form coagulating ferment. He reports some very striking cases in which the x-rays were used to hasten coagulation in cases of intractable hemorrhage. Neuffer [48] confirms Stephan's clinical observations. Szenes [46] reports that blood clots more readily after irradiation of lymphatic tissues in general. Saelhoff [47] reports that irradiation (5 in. back spark, 4 mm. Al, 8 ma., 10 in. focal distance, time, ten minutes) of the splenic, hepatic and intestinal areas made the blood more coaguable. Foster and Whipple [48] report a rise in fibrin values after irradiation of the intestinal and thoracic areas (350 ma. min.) and state that "any cell injury in the body, with or without any inflammatory reaction, will cause this characteristic reaction with prompt rise in blood fibrinogen values."

The concensus of opinion and weight of the evidence seems to be that the effect of x-ray on coagulation is not a specific stimulation effect, but is due to a tissue injury.

Lymph Glands: It is generally known and agreed that a dose slightly more than an erythema dose, if repeated four or five times within a period of two months, will cause an atrophy of lymphoid tissues.

Murphy [50] reports that large doses of x-rays cause a diminution, and small doses an increase of circulating lymphocytes. This was confirmed by Thomas, Taylor and Witherbee [51] but Mottram and Russ [52] who have done much work on the biological action of x-rays, show that if the above investigators had made blood counts soon after x-ray exposure, that is, one hour after, they would have observed a lymphopenia when small doses of x-rays were used. In other words, even with small doses of x-rays a lymphopenia precedes the lymphocytosis, the latter being a physiological reaction to the lymphopenia. Mottram and Russ suggest further that the terms, "destroying and stimulating doses," used by Murphy, may prove misleading, for they are apt to give the impression that essentially different effects are observed after short and prolonged exposure to x-rays."

Summary

With the exception of the germinal epithelium of the gonads, glandular epithelium is quite resistant to the effects of x-rays. The literature presents worthy evidence that the glandular activity of some of the glands can be decreased. The dosage of x-rays required in each instance has not been accurately determined. As to stimulation of glandular activity by small doses of x-rays, we are of the opinion that the literature suggests the possibility of such, but that it has not been demonstrated as yet in a single instance.

PART II.

Studies on the Effect of X-rays on Glandular Activity

The Submaxillary Gland

In the preliminary report of our work on this subject [53] we have referred to certain criteria that must be followed, where the physiology of the gland will permit, in order to make work on this subject accurate. We have also given explanatory reasons why we have selected the submaxillary gland as the first gland for study in our series of studies.

So far as we are able to find from a review of the literature, Horowitz [54] has been the only investigator who has studied the effect of radioactivity on the submaxillary gland. He concludes from his observations, which were wholly histological, that the submaxillary gland tissue is not very sensitive to radioactivity.

Methods

Our experimental methods may be classified as acute and chronic, the acute experiments lasting from three to five hours, the chronic from one to nine months.

Acute Experiments: The methods used in our acute experiments have been described in sufficient detail in the preliminary report. [53]

Chronic Experiments: The chronic experiments have been performed on dogs with a Wharton's duct fistula.

Table I

Effect of Prolonged Experimentation upon the Blood Volume Flow and Secretory Response of the Submaxillary Gland. Dog: Acute Experiment.

PROCEDURE	Saliva in drops on stim. of Chorda	Volume Blood Flow in c.c. per min. Before stim. of Chorda	After Stim. of Chorda	REMARKS
At Beginning of Experiment	54 gtt.	1.4 cc	5.8 cc	
1/2 hr. later	44	1.5	6.4	
1 hr.	31	1.4	5.2	
2 hr.	40	1.4	4.0	26% reduction in saliva 31% " " post-stim. flow

Chorda stim. 10 sec. with same current every 15 minutes.

[53-5] The method for the quantitative collection of the saliva has also been described. [53]

Six dogs with salivary fistula have been prepared and studied. The continuous secretion and the salivary response to standard stimuli have been determined and studied before and after various x-ray exposures. The standard stimuli were as follows: (1) The response to 0.5 per cent HCl solution applied to the oral mucosa for one minute was determined. The saliva was collected for one and a half minutes from the time the acid solution was first applied. The acid solution was applied by means of a forceps and a cotton sponge. The cotton sponge was approximately constant in size and applications of the acid solution were made ten times during the minute of application. So the amount of acid solution applied, the strength of the acid solution and the amount of oral mucosa brought into contact with the solution was constant. It will be noticed from the tables that the amount of salivary response is not constant, which is due to physiological variation. This means that only those averages and variations above or below the maximum and minimum are to be interpreted in drawing conclusions. (2) The response to two minutes eating of roast beef salted to taste was determined. Its dryness and saltiness was kept as near constant as possible because these are factors which influence salivary response. [55] Here again the normal physiological variation in the secretory response was noted. (3) The response to the hypodermic injection of five milligrams of pilocarpin hydrochloride was determined. The injections were made in all instances into the loose subcutaneous connective tissue of the posterior thoracic region on either side. The latent period before the gland showed stimulation was noted and the secretion during the first five minutes of stimulation was collected separately and then the secretion for the next thirty minutes was collected. This differential collection was made in order to detect if there might be a change, not only in the total response of the gland, but also in the rate of response or sensitiveness of the gland when stimulated by pilocarpin. The response of the gland to pilocarpin was quite constant unless the animal vomited.

Chemical determinations of total solids, inorganic and organic solids were made on practically every quantity of secretion collected

Viscosity was determined by an Ostwald pipette, the pipette being standardized against redistilled water. Six seconds was the time required for redistilled water to flow from the pipette when in the vertical position.

Determinations of pH were made by the colorimetric method, using phenolsulphonephthalein as an indicator.

The salivary diastase was determined; it is well known that only traces are present in the saliva of the dog, these traces being probably only a filtrate from the blood.

X-RAY DOSAGES USED

In some of our work we used chiefly three doses of x-ray and for brevity we will refer to them as Dose I, II, and III. In other parts of our work we used varying doses, and when we refer to this we will give in detail the doses used.

Dose I consisted of 50 kv. max., 5 ma., 30 cm. focal distance, portal of entry 6 cm. in diameter, 10 min. exposure and no filter.

Dose II consisted of 100 kv. max., and the "set up" as in Dose I.

Dose III consisted of 145 kv. max., and the "set up" as in Dose I.

RESULTS

Immediate Effects of X-ray on the Secretory Activity of the Submaxillary Gland

Acute Experiments: Since in the course of our experiments it was necessary to keep the animal under light anesthesia for from two to three hours, it was necessary that some controls be run to see what effect prolonged experimentation itself might have on the secretory response and blood volume flow of the submaxillary gland. Such

Table II

Immediate Effects of Large Dose of X-rays on the Secretory Activity of the Submaxillary Gland. Dog: Acute Experiment X.

Procedure #	Saliva in gtt.		Total Solids		Inorganic Solids		Organic Solids		Remarks
	Non-rayed Gland	Rayed Gland	Non-Rayed Gland	Rayed Gland	Non-rayed Gland	Rayed Gland	Non-Rayed Gland	Rayed Gland	
Normal Response. Control	39	48	1.07	1.07	0.33	0.17	0.74	0.89	Most active gland treated
After X-ray 50 K.V.-3 ma-10 min.	28	40							
After X-ray 75 K.V.-3 ma- 10 min.	20	33							
After X-ray 80 K.V.-5 ma-10 min.	14	25							
After X-ray 110 K.V.-5 ma- 10 min.	12	20							
After X-ray 110 K.V.-9.5 ma-10 min.	17	18							Increased Stim. Slightly.
Repeated Stim. with a 25% stronger Stim.Current	28	26							255 ma-min
After X-ray 110 K.V.-9.5 ma-10 min.	32	10	0.73	0.85	0.31	0.18	0.42	0.67	350 ma-min

Focal distance 30 cm.; portal diameter 6 cm.; 10 minute rest between each exposure.

Note that the gland was not stimulated nor sensitized by the first dose. Pilocarpin was injected in one case following extensive exposure with the result that the x-rayed gland only yielded 75 per cent as much saliva as the non-rayed gland.

Table III

Effect of X-rays on Blood Volume Flow and Secretory Response of The Submaxillary Gland.

Procedure	Non-rayed Gland	Rayed Gland			REMARKS
	Saliva gtt.	Saliva gtt.	Blood Ante-stim.	Blood Post-stim.	
Normal at beginning of Expt.	52	41	1.6 cc	5.6 cc	
Immediately after 1st X-ray Dosage	53 (12 min)	30			No stimulation No sensitization
Immediately after 2nd X-ray Dosage	55 (42 min)	21	1.2 cc	4.25 cc	Blood flow:-
Immediately after 3rd X-ray Dosage	25 (1¼ hr)	11	.7 cc	3.4 cc	56% reduction of contin. 40% reduction of post stim. flow

First X-ray Dosage: Dose I and repeated before second x-ray.
Second " " Dose II and repeated before third x-ray.
Third " " Dose III and repeated before last stimulation.

Total 300 ma. min. within a period of two hours.

a study has been made by Gesell [56] but we thought it worth while to run such a control under our own experimental conditions.

Table I shows that prolonged experimentation under our experimental conditions causes a 26 per cent reduction in the secretory response of the gland, no reduction in the continuous volume flow of blood though the gland, and a 31 per cent reduction in the post-stimulation volume flow of blood through the gland when the chorda tympani nerve is stimulated for ten seconds every fifteen minutes for two hours. In three hours time the reduction in the secretory response may be as great as 50 per cent, as is shown in Tables II and III.

This effect of prolonged experimentation shows that it is necessary to run both glands at the same time, using one as a control and x-raying the other. This we have done in practically every instance, irradiating the most physiologically active gland in order to make our results more significant.

Do small doses of x-ray stimulate secretion or sensitize the gland to nervous stimulation when the animal is under acute experimentation? If small doses stimulate, there should be an augmentation in the flow of the continuous secretion. If small doses sensitize the gland to nervous stimulation there should be a greater than normal response when the chorda tympani nerve (the secretory and vasodilator nerve) is stimulated.

Our tracings show the number of drops of saliva produced by the continuous secretion of the gland in seven dogs to be from none to two drops per minute. Dose I, or a dose the same as Dose I with three ma. for five minutes or for ten minutes, does not produce an augmentation in the flow of the continuous secretion. These doses are alleged "stimulating doses."

Table II and Figure 1 show that small doses of x-ray do not sensitize the gland to nervous stimulation and that large doses of x-ray under acute experimentation reduce the response of the gland to nervous stimulation. From 250 to 350 ma. minutes with gradual increase in the kilovoltage (see table) is required to produce this effect.

Pilocarpin was injected in one experiment following the administration of 300 ma. minutes according to the plan shown in Table II with the result that the treated gland only yielded 75 per cent as much saliva as the non-treated gland.

The results of chemical analyses of the saliva collected during the acute experiments varied too widely to be of much significance. Table II shows the change in the chemical nature of the secretion as it occurred in that experiment. A reduction in total solids occurred, which is for the greater part accounted for by a decrease in the organic solids, as is to be expected. The reduction in total solids occurred in about

Table IV

Immediate Effects of Large Dose of X-rays on the Secretory Activity of the Submaxillary Gland in a Dog with a Wharton's Duct Fistula.

Procedure	Amount in cc	Viscosity in seconds	Total Solids %	Inorganic Solids %	Organic solids %	Remarks
0.5% HCl Stimulation before X-ray treatment: Control.	4.8	13	0.9418	0.4734	0.4684	
Continuous Secretion during X-ray treatment of 15 min. Dose III.	.45		0.8071	0.1195	0.6876	
0.5% HCl Stimulation immediately after X-ray	3.2	17	0.9380	0.3262	0.6118	One and half min. interval
Continuous secretion during X-ray treatment of 15 min. Dose III.	.35		0.5622	0.0749	0.4873	
0.5% HCl stimulation immediately after X-ray	4.7	13	0.9795	0.3298	0.6497	
Continuous secretion after acid stimulation without x-ray	.6		0.7247	0.0966	0.6281	
Pilocarpin stimulation 5 mg. One and one-half hr. after X-ray	4.2	7	0.3766	0.0853	0.2913	Normal response #

#Normal response, 6 cc; viscosity, 23 seconds; chemical constituents reduced from 50 to 60 per cent.

Table V

Effect of X-rays on the Secretion of the Submaxillary Gland of the Dog: Fistula of Wharton's Duct.
Dog 1.

Procedure	Amount of Saliva in c.c.			Viscosity of Saliva *			P.H. of Saliva	Remarks
	Max.	Min.	Avg.	Max.	Min.	Avg.		
Controls before X-ray								
15 minutes continuous secretion	0.3	0.0	0.1					
5% HCl Stimulation 1 minute	4.2	2.0	3.4	30"	12"	19"		
Meat Stimulation 2 minutes	3.5	2.0	3.0	12'	2'-30"	9'		
Pilocarpin Stimulation 5 minutes collection	7.0	5.0	6.0	30"	18"	24"		
Pilocarpin Stimulation 35 minutes collection	30.0	23.0	25.0			2'		
1 month # after X-ray								
15 minutes continuous secretion	0.2	0.0	0.05					
5% HCl Stimulation 1 minute	4.0	2.7	3.3	16"	14"	15"		
Meat Stimulation 2 minutes	2.8	1.6	2.0	2'20"	11'45"	2'		
Pilocarpin Stimulation 5 minutes collection	2.0	1.5	1.8	20"	13"	16"		
Pilocarpin Stimulation 35 minutes collection	10.0	6.0	7.5			20"		

*Viscosity measured with an Ostwald pipette.
1st effects noticed 7 da. after 1 dose of Dose III.
Average taken from six to ten experiments.
Dosage: Six doses each of I and II, and two doses of III within 30 days.

one-half of our experiments, while in the others the opposite occurred, but the change was still accounted for by a change in the organic solids. The viscosity was increased or reduced as the organic solids were increased or reduced. In our experiments in which the total solids were increased, the increase was greater in the treated gland than in the non-treated gland. When a decrease occurred in the total solids the decrease was greater in the non-treated gland than in the treated. So in the acute experiments the organic constituents of the secretion were more subject to the influence of the x-ray than the inorganic.

What is the immediate effect of x-ray on the blood volume flow of the gland? The small doses of x-ray, although unfiltered rays were playing directly on the gland tissue, had no effect on the blood volume flow. Large doses (300 ma. min.), Table III, had an apparent vasoconstrictor action on the blood vessels in that blood volume flow was decreased more than in a normal control (Table I.)

We believe, however, that this reduction in blood volume flow is not to be interpreted as due to vasoconstriction, but as due to a passive hyperemia. The reduction in the blood volume flow of the continuous flow causes us to make this interpretation of our results. We do not deny that this observation might be an artefact and we intend to do further work on this question. But, in view of the observations of Halkin [57] and Thies [58] that show that the x-ray causes a loss of tone of the wall and a swelling of the endothelium of the blood vessels, occurring twenty-four hours after exposure, and in view of our own observation on the effect of large doses of x-ray on the blood vessels of the ear of the rabbit and cat, we think that our interpretation is warranted.

Chronic Experiments: What is the effect of small doses of x-ray on the continuous secretion of the gland with fistula of its duct? The continuous secretion of seven submaxillary glands with a fistula of Wharton's duct varied from 0.1 c.c. to 0.5 c.c. in fifteen minutes. We have subjected the glands to the following exposures of x-ray: 40 kv. max., 3 ma., 30 cm. focal distance, 6 cm. diameter portal of entry, no filter, for five and ten minutes; also to Doses I, II and III for ten minutes. Following these exposures we have not observed, even in a single instance, either an immediate, transient or permanent increase in the continuous secretion. The animals must not be allowed to lick the nose as that causes an augmentation of the continuous secretion. The dogs were trained to lie quietly while the treatments were given.

We have constantly made the observation that while the animals are being subjected to large doses of x-ray (Dose III for ten, fifteen or twenty minutes) never more than one or two drops of saliva would flow from the fiistula, even though during the ten or fifteen minute period prior to the exposure from 0.1 to 0.3 c.c. of saliva was collected. This observation may be due to a psychic inhibitory phenomenon (xerostomia), because as soon as the dogs were put back into the stock the continuous secretion returned to normal, but was not greater than normal.

Do small doses of x-ray sensitize the gland to reflex or direct stimulation? Even though small doses of x-rays have no effect on the continuous secretion of the submaxillary gland, it is possible that the gland might be rendered more sensitive to reflex or direct stimulation.

In order to answer this question we made from six to twelve control observations in dogs having a Wharton's duct fistula. These observations extended over a period of from four to six weeks and took note of the response of the gland when stimulated reflexly by acid application to the oral mucosa and by the eating of meat, and when stimulated directly by pilocarpin, which acts on the postganglionic autonomic nerve endings in the gland. The large number of control observations were made in order to definitely ascertain the normal physiological variations of the gland in response to stimuli, thereby obviating any misconstruction of results following the radiation of the gland. We then treated the gland with x-ray, making observations immediately following treatment, and at intervals of from two to three days for a period of two weeks. Following Dose I no change

Table VI

Showing Effect of X-ray on Secretion of the Submaxillary Gland Two Months after Last Exposure and Showing no Effect of Secondary Radiation on the Non-rayed Gland.

Dog 1

Procedure	Saliva Amount in cc. Average	Visc'ty in Seconds	Total Solids %	Inorganic Solids %	Organic Solids %
Left Gland Before X-ray					
Acid Stimulation	3.4	19"	1.0696	0.5698	0.5001
Meat Stimulation	3.0	9'	2.0782	0.3512	1.7436
Pilocarpin 5 min.	6.0	24"	0.8799	0.4763	0.4036
Pilocarpin 35 min.	25.0	2'			
Left Gland After X-ray - 2 months					
Acid Stimulation	1.7	1'	1.5957	0.5036	1.0921
Meat Stimulation	1.3	8'	2.1793	0.5879	1.5914
Pilocarpin 5 min.	1.3	50"	0.9772	0.3873	0.5899
Pilocarpin 35 min.	7.6	20"			
Right Gland Non-rayed control					
Acid Stimulation	3.3	25	1.2180	0.6824	0.5756
Meat Stimulation	2.9	6'	2.2060	0.4331	1.7290
Pilocarpin 5 min.	7.0	1'	1.1780	0.5678	0.6102
Pilocarpin 35 min.	24.0	3'			

The figures are averages of from six to ten experiments.
Left gland was given six doses each of Dose I and II, and two doses of Dose III within a period of four weeks.

Table VII

Showing Progressive Differential Effects of X-ray on the Secretion of the Submaxillary Gland.

Dog 6

Procedure	Saliva Amount in cc	Viscosity in Seconds	Total Solids %	Inorganic Solids %	Organic Solids %	
Gland before X-ray						
Acid Stimulation	3.9	16"	1.149	0.536	0.613	
Meat Stimulation	3.5	8'	2.016	0.555	1.451	
Pilocarpin 5 min.	6.8	2 0"	.990	0.523	0.467	Latent period 3½ min
Pilocarpin 35 min	31.0	1'10"				
Gland 2 weeks after last treatment						
Acid Stimulation	3.8	45"	1.532	0.185	1.346	
Meat Stimulation	1.5	1'15"	1.440	0.246	1.193	
Pilocarpin 5 min.	6.0	30"	1.040	0.323	0.927	Latent period 5 min
Pilocarpin 35 min.	21.0	3'				
Gland 7 weeks after last treatment						
Acid Stimulation	0.2					
Meat Stimulation	0.1					
Pilocarpin 5 min.	1.0		No determination made			Latent period 9 min
Pilocarpin 35 min.	3.5	2'15"				

X-ray dosage: 6 exposures of dose I and 8 exposures of dose II within a period of two months. First effect noted two weeks after the last exposure. Figures are averages of from four to eight experiments.

in the response of the gland was noted. No immediate change occurred in the response of the gland when Doses II and III were used. The permanent effects will be referred to presently.

What is the immediate effect of large doses of x-ray on the secretory response of the gland? Because we obtained evidence of the immediate suppressive action of large doses of x-ray on the response of the gland in our acute experiments, we were of the opinion that the same effects could be demonstrated on the dog with a Wharton's duct fistula. However, Table IV shows that no immediate effect occurs, except possibly in the case of stimulation by pilocarpin. On another dog we tried a still larger dose (110 kv. max., 10 ma., 10 in. focal distance, 6 cm. diameter portal of entry, 1 mm. Al filter, time, thirty-three minutes) without observing any immediate effects. In this experiment acid stimulation was used. Immediately before x-ray exposure the gland secreted 3.5 c.c. of saliva and immediately after x-ray 3.7 c.c., which is well within the normal physiological variation of the secretory response of the gland to acid stimulation.

Histology of Immediate Effects of Large Doses of X-rays

We have made histological studies of the x-rayed gland when compared to the gland on the other side which had not been radiated. The glands were removed immediately following the experiment. The usual hematoxylin and eosin staining technique was used. We have been unable to observe any evidences of histological change immediately following relatively large doses of x-ray. We hoped to be able to find evidence of passive hyperemia and swelling of the endothelium of the blood vessels, but with the technique we have used up to date, we have been unable to demonstrate such changes.

Delayed and Permanent Effects of X-ray on the Secretory Activity of the Submaxillary Gland.

Chronic Experiments on Wharton's Duct Fistula Dogs: What is the effect of the fistula per se on the secretory activity of the gland? It is possible that the abnormal position of the papilla of the duct (transplanted from the mouth to the submental region) might have some effect on the secretory activity of the gland. In order to answer this question, we followed the continuous secretion and the secretory response of the gland to acid, meat and pilocarpin stimulation in two dogs which had had at that time a Wharton's duct fistula for a priod of two and three months, respectively. We found that in these animals the secretion was influenced neither quantitatively nor qualitatively.

What is the delayed effect of x-ray on the continuous secretion of the submaxillary gland? We have pointed out before that small doses have no effect, immediate or delayed, on the continuous secretion. Tables V and VI show the reduction in the continuous secretion one and two months following relatively large doses of x-ray. When one large dose (110 kv. max., 10 mm., 10 in. focal distance, 6 cm. diameter portal of entry, 1 mm. Al filter for thirty-three minutes) was given, a reduction was noticed seven days later. Hence, a reduction in the amount of continuous secretion occurs when large doses of x-ray are used.

What is the delayed effect of x-ray on the secretory response of the gland to reflex and direct stimulation? This question is answered by the results shown in Tables V and VI. The effect of the rather intensive treatment is first observed from ten to fourteen days following the treatment and manifests itself by a differential depression in the secretory response of the gland to pilocarpin and to the chewing of meat, the secretion resulting from acid stimulation being normal in amount. The response to eating meat in all but one dog was the first to show reduction, generally from three to five days before the pilocarpin response was reduced. Table VI shows that after two months the response to acid stimulation is also markedly reduced.

That this suppression in the response of the gland was not due to a general

Table VIII

Showing Progressive Differential Effects of X-ray on the Secretion of the Submaxillary Gland.
Using the Minimum Dose Necessary to Effect the Gland.

Procedure	Saliva Amount in cc.	Viscosity Amount in Seconds	
Before X-ray			
Acid Stimulation	3.3	25"	
Meat Stimulation	2.9	6'	
Pilocarpin 5 min.	7.0	1'	Latent period 4 min
Pilocarpin 35 min.	24.0	3'	
2 weeks after X-ray		23"	Effects first noted
Acid Stimulation	3.4		
Meat Stimulation	1.3	5'	on the 10th day
Pilocarpin 5 min.	2.3	3'35"	latent period 4 min.
Pilocarpin 35 min	17.5	50"	
4 weeks after X-ray			
Acid Stimulation	2.0	28"	
Meat Stimulation	1.5	1'58"	
Pilocarpin 5 min.	1.0	20"	latent period 6 min.
Pilocarpin 35 min.	9.0	4'15"	

X-ray Dosage: 110 kv. max.; 10 ma.; 35 cm. focal distance; 6 cm. diameter portal; 1 mm. Al filter; 40 minutes

Table IX

Showing No Effect of Small Dose of X-ray on Submaxillary Gland Suppressed with Atropin. Dog with Wharton's Duct Fistula.

Procedure	April 25th		May 5th X-ray #	
	Saliva Amount cc.	Viscosity in Seconds	Saliva Amount cc.	Viscosity in Seconds
.5% HCl Stim. Control	3.6	45"	3.7	1'10"
Hypodermic Injection 1.2 mg Atropin Sulph.				
.5% HCl Stim. 10 min. after Inject.	0.5		0.6	
.5% HCl Stim. 1/2 hr. after Inject.	0.6	2'	0.6	1'50"
.5% HCl Stim. 1 hr. after Injection	1.2	1'50"	1.0	1'15"
.5% HCl Stim. 1 1/2 hr. after Inject.	1.4	1'20"	1.3	1'20"
.5% HCl Stim. 2 hr. after Injection	1.5	44"	1.7	1'10"
.5% HCl Stim. 2½ hr. after Inject.	2.7	41"	[illegible].4	45"
.5% HCl Stim. 3 hr. after Injection	2.8	40"	2.5	35"

Dose: 60 kv. max.; 3 ma.; 30 cm. focal distance; 6 cm. diameter portal, no filter; 10 min.
Exposure given April 27th. Same response on April 27th and May 1st.

systemic effect is also shown by the results recorded in Table VI and by the observation that saliva flowed freely from the mouth, the source being from the non-rayed gland, when pilocarpin was injected, while but very little saliva was produced by the irradiated gland.

The normal latent period between the injection of pilocarpin and its effect on the gland varied normally from three to five minutes. After x-ray the latent period was increased to seven and eight minutes.

Table VIII shows the effect of what we have determined to be the minimum dose necessary to have any demonstrable influence on the secretory response of the submaxillary gland in a normal dog with a Wharton's duct fistula.

The Immediate or Delayed Effect of Small Doses of X-ray on the Secretory Response of the Submaxillary Gland Suppressed with Atropin.

Even though a small dose of x-ray has no stimulating effect on the normal gland, it is possible that such a dose may stimulate a gland that is suppressed or secreting below normal. In order to ascertain if such is the case we injected subcutaneously in a dog with a Wharton's duct fistula 1.2 mg. of atrophin sulphate, which was sufficient to suppress the secretion of the gland, but not to abolish it. We then stimulated the gland reflexly by acid application to the oral mucosa at one-half hour intervals for three hours after the injection. We ran four control experiments prior to x-ray exposure of the gland, and then an experiment immediately after x-ray exposure and at intervals of three days for two weeks after exposure. Our results failed to demonstrate that the gland suppressed with atropin was sensitized or stimulated by exposure to small doses of x-ray either immediately or several days after exposure. We used three different doses of x-ray as follows: (1) 40 kv. max., 3 ma., 30 cm. focal distance, 6 cm. diameter portal of entry, no filter, five minutes; (2) 60 kv. max., 3 ma., 30 cm. focal distance, 6 cm. diameter portal, no filter, for ten minutes; (3) 110 kv. max., 10 ma., 30 cm. focal distance, 6 cm. diameter portal, no filter, ten minutes.

Table IX shows a typical result of no effect from the dosage in that series of experiments.

The Effect of Relatively Large Doses of X-ray on the Composition of the Saliva.

Table IV shows that x-ray exposure causes no immediate change in the composition of the saliva in dogs having a Wharton's duct fistula, which has been verified by other experiments on other dogs.

On the delayed effects of x-ray on the composition of the saliva our results are variable, as shown in Tables VI, VII, X and XI. The most decided change in composition was in the case of the saliva produced by meat stimulation. All of our animals showed a reduction in the viscosity and total solids of the "meat saliva" within the first month. In all cases this reduction of total solids was about equally distributed between organic and inorganic solids, but in one case (Table XI) a reduction of organic solids alone occurred. We are unable to make any definite statements concerning any change in the composition of the "acid and pilocarpin salivas."

After a period of from two to three months after exposure the composition of the saliva returns to approximately normal (Table VI) or slightly above normal, which demonstrates that the gland cells not destroyed by the x-ray are functioning normally and that the permanent reduction in the quantity of the secretion is due to a destruction of gland cells, as is to be pointed out by the results of histological studies.

PART III.

The Effects of Relatively Large Doses of X-ray on the Histology of the Submaxillary Gland.

Immediate or Acute Effects: In all cases the non-irradiated gland from the

Table X

Effect of X-rays on the Composition of the Secretion of the Submaxillary Gland of the Dog. Fistula of Wharton's Duct.

Dog 2

Procedure	Total Solids in percent			Inorganic Solids in percent			Organic Solids in percent		
	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
Controls before X-ray									
15 minutes Continuous Secretion	1.724	0.833	1.327	0.515	0.140	0.308	1.264	0.543	1.006
.5% HCl Stimulation - 1 minute	1.341	0.723	1.016	0.585	0.283	0.404	0.839	0.338	0.608
Meat Simulation * 2 minutes	2.306	1.912	2.109	0.490	0.303	0.419	2.000	1.421	1.691
Pilocarpin Stimulation 5 mg. 5 min.	1.228	0.663	0.907	0.495	0.334	0.416	0.768	0.309	0.491
1 Month after X-ray #									
15 minutes Continuous Secretion									
.5% HCl Stimulation 1 minute	0.979	0.664	0.880	0.473	0.152	0.320	0.649	0.468	0.560
Meat Stimulation 2 minutes	1.704	1.064	1.342	0.231	0.070	0.134	1.604	0.994	1.208
Pilocarpin Stimulation 5 mg. 5 min.	0.896	0.376	0.636	0.110	0.085	0.097	0.786	0.291	0.538

* Dry roast beef was used. #Dog had six doses each of Doses I, II and III.

Average of from six to ten experiments.

Table XI

Effect of X-ray on the Composition of the Secretion of the Submaxillary Gland of the Dog. Dog with Fistula of Wharton's Duct.

Dog I

Procedure	Total Solids % Average	Inorganic Solids % Average	Organic Solids % Average
Controls before X-ray			
Acid Stimulation	1.069	0.569	0.500
Meat Stimulation	2.078	0.351	1.727
Pilocarpin Stimulation 5 min	0.879	0.476	0.403
1 month after X-ray			
Acid Stimulation	1.193	0.329	0.864
Meat Stimulation	1.697	0.394	1.303
Pilocarpin Stimulation	0.770	0.231	0.539

Average of from six to ten experiments. Dosage: 6 doses each of doses I and II and two doses of III within a period of thirty days.

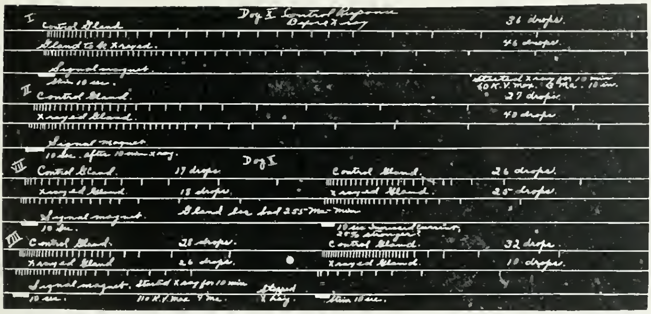


Fig. 1—A portion of the tracings from which the results in Table II were derived. Tracings show the effect of large doses of x-ray on the secretory activity of the submaxilary gland under acute experimentation.

same dog was compared with the irradiated gland. The usual hemotoxylin and eosin staining technique, using 10 per cent formalin, Zenker's and Bouin's fluids for fixation, was used. The glands of six dogs were studied, the dogs being those used in our acute experiments referred to in the first part of our paper. In every instance we were unable to notice any difference between the histological appearance of the irradiated and non-irradiated gland, even though we had in the course of our experiments shown a physiological difference between the two glands.

Delayed and Permanent Effects: The delayed histological changes are quite marked, as judged from our studies on four dogs. Here also we compared the irradiatetd gland with the non-irradiated control. The glands were removed fifteen days and two months following the manifestation of physiological disturbance of the function of the gland. At fifteen days the glands showed the following changes: (1) Infiltration of round cells about the secretory ducts, blood vessels and in the stroma of the gland; (2) a reduction in the amount of stored mucus in the cells of the alveoli with evidences of degeneration of some of the gland cells; and (3) a proliferation of fibroblasts in the stroma of the gland. No hemorrhages or signs of previous hemorrhage were present. At two months the glands showed the following changes: (1) They were smaller in size than the normal control and more firm in consistency; (2) there was less round cell infiltration than was found in the glands studied at fifteen days; (3) the fibrous tissue stroma was markedly increased in amount, and (4) the cells of the alveoli were loaded with stored mucus.

These histological findings of the delayed effects of x-ray on the histology of the gland correspond with the changes in the physiology of the gland; for example, the reduction of the viscosity and total solids as well as quantity of the secretion during the first month and the returning to normal of the composition of the secretion with a permanent reduction in the quantity.

Discussion

Some of our observations call for an explanation and a discussion.

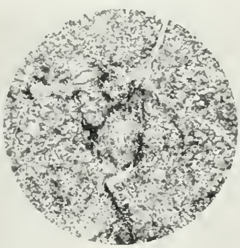
It is to be recalled that in our acute experiments we observed a depression of the gland when irradiated with large doses of x-ray, which did not occur in our experiments with the dogs having a Wharton's duct fistula. We can only explain this apparent discrepancy by assuming that in the acute experiments the gland was depressed or altered as a result of the effects of the ether and acute experimentation and hence a slight immediate depressive action of the x-ray was able to make itself evident.

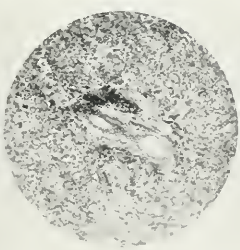
It is interesting to note that following the large doses of x-ray we did not obtain a "paralytic secretion" as is observed when the chorda tympani nerve is sectioned. This demonstrates that the quantitative and qualitative change in the secretion after x-ray is most probably not due to any action of the x-ray on the chorda tympani.

We can best account for the differential depression of the secretory response that occurs during the first month by assuming that pilocarpin and meat stimulation are submaximal stimuli when compared with acid stimulation and therefore any depression of the secretory response would first become evident when submaximal stimuli were used.

The reduction in the quantity of the secretion is adequately explained by the histological changes in the gland after x-ray, the proliferation of fibroblasts, the increase in the connective tissue and the decrease in the glandular tissue of the gland which make it impossible for the gland to produce a normal amount of secretion.

The reduction of the total solids of the "meat secretion" during the first month shows that the gland cells themselves are affected by the x-ray and that they are not forming a secretion of normal consistency. This change is more evident for the "meat secretion" because of its concentration. That the gland cells are affected by the x-ray is further evidenced by their actual destruction and replacement by connective tissue cells, as pointed out before (Fig. 5).





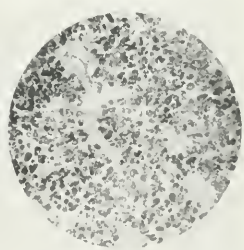


Fig. 2—A normal control gland from the same dog from which Figure 3 was taken. Magnification x 65.

Fig. 3—An irradiated gland removed fifteen days after manifestation of a physiological change, showing a sterile abscess surrounded by round cells which radiate off along the course of a blood vessel, other areas of round cell infiltration of the stroma and a reduction in the "stored mucus" and an increase in the amount of connective tissue stroma cells (fibroblasts). Magnification x 65.

Fig. 4—A high power view of an irradiated gland two months after manifestation of a physiological change, showing marked increase in fibrous tissue and the presence of "stored mucus" in the cells of the alveoli.

Fig. 5—An irradiated gland two months after manifestation of a physiological change showing marked increase in fibrous tissue and the presence of "stored mucus" in the cells of the alveoli.

Our observation on the effect of small doses of x-ray on the gland suppressed with atropin are interesting because they show that the continuous secretion of the suppressed gland is not augmented and that the gland cell is not sensitized to reflex stimulation. This argues against any therapeutic benefit of stimulating doses of x-ray in cases of xerostomia. It does not prove, however, that no beneficial results would occur, because the etiology of chronic xerostomia is not known and its etiology may not simulate atropin depression of the gland. We hope to be able to answer this question by exposing the salivary glands of such cases to x-ray.

It is interesting to note that our results demonstrate that the Witherbee dosage of x-rays for the treatment of hypertrophied tonsils will not injure the submaxillary gland.

SUMMARY

In acute experiments we were unable to demonstrate that small doses of x-ray stimulate or sensitize the submaxillary gland. Our results show that large doses of x-ray in acute experiments cause an immediate depression of the secretory activity of the gland which may be explained by an altered blood flow through the gland.

In dogs with a Wharton's duct fistula we were unable to demonstrate that small doses of x-ray stimulate or sensitize the submaxillary gland. Large doses of x-ray do not cause an immediate depression of the secretory activity of the gland, but a differential depression in secretory activity occurs which is first manifested from ten to fourteen days following the exposure of the gland.

One month after exposure, the gland manifests a depression to all stimuli used. An alteration in the composition of the saliva occurs. Two months after exposures the secretion remains markedly reduced in quantity, but its composition returns to normal. The depression is not due to any general systemic effect of the x-ray exposure.

Fistula of the duct of the gland does not alter its secretory activity.

The minimum dose required to produce depression of the secretory activity of the submaxillary gland is as follows: 110 kv. max., 10 ma., 25 cm. focal skin distance; portal of entry, 28 cm. square; 1 mm. Al filter; time, forty minutes.

The submaxillary gland partially suppressed with atropin is neither stimulated nor sensitized when exposed to small doses of x-ray.

The effect of large doses of x-ray on the histology of the submaxillary is reported.

Note: Results on the effects of x-ray on the secretory activity of the gastric glands were reported at the St. Louis meetings of the Radiological Society of North America. These results will be reported later in another paper.

Fig. 6—The photograph demonstrates the method used in collecting the saliva from an animal with a Wharton's duct fistula. Attention is especially called to the glass funnel attached to the skin about the fistula with flexible celloidin, and to the glass test tube used for collecting the saliva. The tube is fastened to the funnel with wax.

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Diaphragmatic Hernia--Non-Traumatic: With Report of Four Original Cases

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DIAPHRAGMATIC hernia caused by trauma is not rare. Congenital diaphragmatic hernia is quite infrequent. The clinical history can so simulate other diseases that unless hernia is thought of the patient will go through life with the true condition unknown. Symptoms may be few and not pressing, and such cases often are not detected.

My interest was aroused, when in a single year, I found three cases of hernia of the diaphragm with no known history of injury. In the following year I detected a fourth case with no known history of injury. Two of these patients were referred for a gastro-intestinal examination because of digestive disturbance, one was referred to confirm a pneumothorax and the fourth case was referred for an examination of the heart.

Etiology

The causes of traumatic hernia are crushing injuries, gun shot wounds and injury of the diaphragm with the aspirating needle. Congenital hernia is probably due to an imperfect development.

Position

The opening can be at any place in the diaphragm. In my four cases, two had an abnormally large opening for the esophagus. Two had openings through the dome of the diaphragm. Some reported cases have openings in the right and left diaphragm.

Symptoms

The abdomen may be contracted. Pains are usually in the lower left chest which will have a resonant note if the stomach is full of gas, and there will be absence of breath sounds over the left lower chest. Vomiting is not always present. There is distention and dyspnea, at times regurgitation of food, obstruction, and, if the hernia should become partially strangulated, there is shock. The chest will show no change in appearance.

The symptoms are those of interference with gastric function and embarrassment of respiration. The gastro-intestinal symptoms may be absent.

Literature

The literature is meager. In the May, 1920, issue of the American Journal of Roentgenology, Webster W. Belden, M.D., of General Hospital No. 41, says: "Prior to the great war, cases of hernia of the diaphragm, with either stomach or colon passing into the thoracic cavity, were decidedly rare. In fact, in 1908 the most recent text books did not even mention the images furnished by this type of lesion."

Foster, in the New York Medical Journal, Vol. 112, page 77, 1920, reports a case that he says would have remained a sealed book except for the postmortem examination. The patient, a young man 24 years old, was admitted to the hospital on account of severe indigestion. He said he had always had some trouble with the stomach and was subject to attacks of abdominal pains accompanied by nausea, but did not usually vomit. The case was regarded as chronic appendicitis. The particular attack which brought him to the hospital was similar to other attacks. The pains increased so that he soon was bordering on collapse. The temperature was normal and he was bathed in a cold sweat. The pains were localized over the left upper abdomen. Examination revealed a tympanitic note over the left lower chest to the fifth rib in the axillary line. Over this area the breath sounds were absent. The diagnosis was pneumothorax. The patient did not rally and died within twenty-four hours.

The postmortem showed a diaphragmatic congenital hernia. The stomach and small intestines were in the thoracic cavity.

The British Medical Journal, Sept., 1919, reports a patient, a soldier, who suffered much pain after food of any kind and who was sick in the hospital much of the time. He was given medicines and duty, but with no improvement. Finally he was sent home as a case of gastritis. He again was hospitalized and this time because of a wound on the abdomen and a corresponding wound on the back it was thought possible he might have an hour-glass stomach. Upon x-ray examination the greater part of the stomach was found to be in the chest cavity. This case, of course, is classed as traumatic hernia.

Richard Warren, M.D., in the Lancet, Jan. 21, 1919, says: "Hernia of the abdominal viscera through the diaphragm is tolerably rare, but is likely to be more commmon in the future, as the result of battle wounds."

The records of the East London Hospital show seven cases. Three were gun shot injuries of the belly and chest. One patient was injured in a buffer accident. Two cases, one 16 and one 30 years of age, gave no history of injury and were possibly due to congenital defects. Another case, a patient 68 years of age, with a long history of wastings and vomiting, but no note of injury, may also be congenital.

Alexander Stewart McMullen, M. D., Chief of X-ray Service U. S. General Hospital No. 1, in the American Journal of Roentgenology, March, 1920, says that among fifteen thousand cases examined in the x-ray laboratory of the hospital, three cases of hernia followed injury. The third case, however, is uncertain, as there was no direct history of injury, but the patient had had pneumonia in the left lung, lower lobe, with empyema following, and as drainage had been employed, there was a chance of an injury. It is of interest that the diagnosis in each case was made in the roentgen laboratory.

John E. Grieve, M. D., Archives of Pedriatics, October, 1920, reports a child five and one-half years old. He says "The history of her illness, in a sense, preceded her birth, inasmuch as the mother at the time of her delivery and immediately thereafter was severely ill with whooping cough. Immediately after birth the child was seized with attacks of coughing, which continued to the fifth year. This child had trouble with digestion, and vomiting was severe. Examination by the barium meal

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 6, 1922.

Fig. 1—(Case 1)—Mr. U.—Note air bell with streaks of barium. First impression is one of eventration.
Fig. 2—(Case 2)—Mr. C.—Irregular heart action and shortness of breath main symptoms. The plate is a twenty-four hour retest, some barium in the colon. Bulb not seen.

showed the stomach partially in the left chest. This case was likely not congenital, but caused by the exertions of the cough."

In the Annals of Surgery, April, 1921, Samuel Gitlow and Ben Breakstone report a patient, a widow, 65 years of age, whose chief complaint was dyspnea (left chest) that dated back many years. There was no history of injury. After all other attempts at diagnosis had been tried the x-ray revealed the stomach in the left chest.

In the British Journal of Surgery, October, 1921, M. Fitz Maurice-Kelley, relates a case of double congenital diaphragmatic hernia in a patient aged 35 years. The colon was involved. The pains came on suddenly and were followed by strangulation. This patient had suffered two attacks previously and had served two years in the war. Congenital hernia was reported at the post-mortem examination, because of the shape of the liver and the abdominal organs.

Louis Frank in the Annals of Surgery, Vol. 71, No. 3, 1920, reports a child 16 years old, who had had indigestion from infancy. Vomiting was a prominent symptom. The history was irregular with gain and loss in weight. Because of the symptoms an obstructed pylorus was thought of. A roentgen examination revealed the stomach in the chest.

L. Blumenfeld, New York Medical Journal and Medical Record, Aug. 2, 1922, reports the case of a newborn child which at birth gave a little gasp and a faint cry and made forced attempts at inspiration. Behrend tried all of the prescribed methods of artificial respiration, but none seemed to relieve the progressive and increasing asphyxia. The child was becoming quite cyanotic and oxygen inhalations were given. As long as the child was kept in a basin of water at body temperature and supplied with oxygen the color remained good, but as soon as the oxygen was taken away the cyanosis returned. The efforts at inspiration gradually became weaker and less labored and the child died an hour and a half after birth. The only external physical defect present was a marked right talipes equinovarus and to a less degree a left talipes equinovarus. On opening the abdomen, the liver was found much enlarged and filling the greater part of the abdominal cavity. The only other visible content of the abdomen was the sigmoid. The descending colon disappeared through a slit in the diaphragm caused by the separation of the diaphragm from the posterior abdominal wall. The opening was about one-quarter of an inch to the left of the aorta. On removing the anterior chest wall the thorax was found filled with small intestines up to the neck. It also contained the entire stomach and the large intestines.

Fig. 3—(Case 3)—Mr. R. G. D.—Shortness of breath with acute pains after eating or drinking. Quantity rather than quality determined severity of the attack. The stomach and bulb is distended but not yet emptying. The esophagus gives the impression of emptying into the bulb. The stomach would hold this position for minutes before the duodenum would fill.

J. S. Latta, American Journal of Diseases of Children, Chicago, October, 1922, cites a case in which there was an almost total deficiency of the left side of the diaphragm. Associated with and doubtless as a result of this, there were found some other minor anomalies, the most evident of which was a displacement of some of the abdominal viscera into the left pleural cavity. It was obvious that these misplaced viscera represented a spurious hernia, due to an arrest in development of the left side of the diaphragm, rather than a true hernia due to a lack of diaphragmatic muscular tonus or development, for these viscera were not enclosed in a hernial sac, but lay free in the pleural cavity.

C. M. Davis, American Journal of Diseases of Children, Chicago, October, 1922, cites the case of an infant which on the eighth day after birth had two transitory attacks of slight cyanosis with rapid breathing, for which examination revealed no cause. The following morning, shortly after nursing, the child suddenly became intensely cyanotic, with rapid dyspneic respiration, and lay limply in the dorsal position, with the appearance of impending death. The cyanosis was somewhat lessened by removing a rather snug abdominal band, and much more by holding the child in a vertical position, but it recurred promptly when the child was laid down. A diagnosis of left diaphragmatic hernia, due to congenital defect of the diaphragm was made and from the absence of vomiting and other gastro-intestinal symptoms, it was thought that the stomach was not involved in the hernia. This was confirmed by fluoroscopic and roentgenographic examination, which showed the stomach to be normal in appearance and position while all the intestines from the duodenum to the descending colon were above the diaphragm in the left chest and the heart was displaced into the right chest.

The following four cases were detected in my laboratory:

Case 1—Mr. U., 27 years of age, served two years in the late war. After his discharge, trying to establish a disability, he presented himself for examination. Shortness of breath and pains in the left lower chest were the main complaints. Pneumothorax had been diagnosed and he was referred to me to confirm findings. The patient stated that he had always been short of breath, which was most noticeable after eating heartily, and that a feeling of oppression in the epigastric region, sometimes amounting to pain, would follow a heavy meal. The same condition

was noticed after drinking more than an ordinary amount of fluid. The patient was well nourished. He had no scars on the belly or chest, and had never been injured, so far as he knew. The belly and chest were normal in contour. Breath sounds were absent over the left lower chest. The heart was slightly displaced to the right.

Fluoroscopic examination showed a domed outline which I thought was the diaphragm. The first impression was one of eventration. A stereoscopic set of plates showed a part of the fundus of the stomach above the diaphragm. In this case the opening through which the esophagus passes is enlarged and about one-half of the stomach is in the chest cavity.

Case 2—Mr. C., 29 years old, was referred for an examination of the chest, particularly of the heart. Heart action was found to be irregular during the periods of suffering and the breath short. Physical exertion and hearty meals always brought on pain. There was no known injury. The condition was marked in early life, so marked that the patient could not take part in the usual school games. Physical examination showed no external marks of violence. The belly and chest form was normal.

Fluoroscopic examination showed the heart displaced to the right and the air bell of the stomach above the diaphragm. Barium was given and part of the stomach was seen to be above the diaphragm. The opening in the diaphragm is about two inches from the esophageal opening. About one-fourth of the stomach is in the chest.

Case 3—Mr. R. G. D., 49 years old, was referred for a gastro-intestinal examination. Complaint had been of long duration, but for the past three years he had noticed that a feeling of fulness after meals was growing more pronounced. At times the pains were acute. Vomiting usually gave relief. What the patient ate mattered little, but the quantity would determine the acuteness of the attack. The color was good, but the weight had decreased about twenty pounds in the past three years. Shortness of breath was marked when pains were acute. The pain point was the pit of stomach.

The examination showed about one-half of the stomach above the diaphragm. The lower part of the stomach was the first to fill and if no more fluid was taken the upper sac remained empty. Taking more resulted in filling the upper sac and produced distress. In this case you will see an unusual arrangement of esophagus, stomach and duodenum. You will see from the plate that the esophagus empties to the liver side of the bulb. Whether this is a

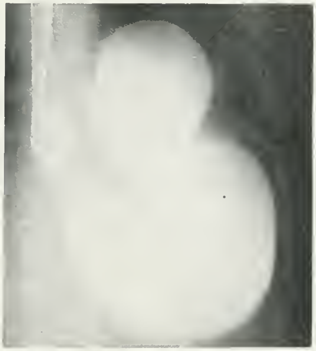

Fig. 4—(Case 4)—Mrs. M. K.—Shows a full stomach which would hold its form for minutes. Nearly the entire stomach is above the diaphragm.

deformity of the stomach or whether it is due to a peculiar lifting up and tying of the stomach in this position, I am unable to say. There was no known history of injury.

Case 4—Mrs. M. K., 62 years old, was referred for gastro-intestinal examination, the complaint dating back many years. She believed the condition had become worse in the five years since a death had occurred in the family. She reported a feeling of fullness after eating, the pains being, however, confined to the chest, so that she felt as though the chest would burst. She reported that vomiting relieved all pain and that she regularly spat up food during the attacks. The first meal of the day seemed to cause the most pain. The patient was thin, was losing in weight and said she was suffering more often and more acutely than in former years. The pains were always in the chest, just back of the sternum. The color was fairly good. The symptoms were very much those of an early partial obstruction of the esophagus.

In examining the patient under the fluoroscope the air bell was noticed above the diaphragm. Two glasses of barium mixture filled the stomach with the entire mixture above the diaphragm. Distress now became acute. Gaining the patient's confidence and assuring her that no harm would occur, it was noticed that some of the barium was showing below the diaphragm. The stream was small but steady. It was noticed that the stomach was following as the barium came down into the belly. The barium was not going into the duodenum, but the stomach was slowly coming through the diaphragm into its proper place, and after twenty minutes practically the entire stomach was in a normal position. By palpation the entire stomach, with the mixture, could be pushed back into the chest cavity. This was repeated a number of times on different days. The findings were constant. The patient was at high nervous tension and it was noticed that irritability on her part prevented the filled stomach from gaining its normal position. The stomach passed in and out of the thoracic cavity through an enlarged esophageal opening. The patient submitted to operation, and two years after the operation was comfortable.

These cases suffice to illustrate the extreme difficulty of diagnosis, even in traumatic cases. The diagnosis is much more uncertain when no known injury has been received.

Summary

Diaphragmatic hernia, traumatic, is uncommon, but not rare.

Congenital diaphragmatic hernia is very infrequent.

The history is unusual.

Fig. 5—(Case 4)—Stomach emptying. Esophagus is seen full, due to regurgitation. Plate taken fifteen minutes after giving barium mixture.
Fig. 6—(Case 4)—About twenty minutes after drinking the mixture. Stomach, except small portion, has regained normal position. Palpation could return the entire mass into the chest. Operation gave relief.

Digestive disturbance may be absent.

Thoracic symptoms may fairly predominate.

Viscera may pass in and out of the thoracic cavity.

The patient may be fairly comfortable.

The clinical history is misleading.

The condition is not fatal unless strangulation occurs.

We cannot be absolutely certain of the existence of non-traumatic hernia. Injury might have been received without a known history.

The use of the x-ray will quickly make plain the condition.

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Comparative Measurements of Intensity and Hardness of X-Rays Produced by Different Types of American Transformers*

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FIRST I want to express to you my gratitude for your kind invitation to read this paper before this famous society. During the last six months I have had the opportunity on trips from coast to coast to see and to measure different kinds of transformers under very different conditions. But these investigations have been performed only in order to answer the questions which the doctors asked me. For instance, how long would it take to cause a mild or a heavy erythema, or why under apparently normal conditions and a certain number of milliampere-hours they did not get the expected skin reaction, or what the distribution of the rays would be in the depth of the human body, or how to produce an intensive and hard radiation in the most economical way, etc. In order to answer these questions I could not make systematic measurements of all electrical and radiological conditions of the various transformers; I could perform measurements only in a limited field of kilovoltage and milliamperage and filtration, such as radiologists require for practical purposes.

I can classify my measurements in the following manner:

(1) I investigated the intensity and hardness and the behavior of the tube under the conditions which the physicians used in treating their patients.

(2) I tried to improve the conditions and measured the same factors under these changed conditions.

(3) I observed intensity and hardness and tube action under the conditions which generally are used in America. I will call them normal conditions, namely,

200 kv.
5 ma.
1 mm. Cu + 1 mm. Al.
50 cm. F. S. D.
New x-ray tube.

The intensity under these normal conditions may be called the normal intensity produced by the transformer.

Concerning the possibility of these measurements I have to make some further explanations:

(1) For comparing intensity measurements we need an instrument which is sufficiently constant, so that reliable measurments can be made. The only method, which permits such measurements is the ionization method. By photographic means there is no possibility of measuring intensities and hardnesses with less error than 20 or 30 per cent. With the ionization method very exact measurements can be made. But with all iontoquantimeters difficulties originate from material leakage, lowering the exactness of the results considerably. I claim that an electroscope is the most accurate instrument. Of course, corrections must be made for the existing atmospherical conditions, either by calculation or by using a constant source of radiation, such as a 5 mg. radium needle. Both methods have been used by myself. Therefore I can compare intensities of different transformers with an error of less than 2 per cent. I would like to give the results of my measurements in electrostatic units, but there are differences between the results of different authors. Therefore, I can give you the results relatively only.

(2) The hardness has been measured as a coefficient similar to the total absorption coefficient with a water filter of 2.3 cm. thickness. With heavy copper filtration this water filter measures the surface hardness, as well as the average hardness to a depth of 10 cm. with a comparatively small error. By comparison with different iontoquantimeters I can estimate the depth dose for 10 cm. depth and a certain port of entry, for instance, $20 cm^2$. The error is very much higher than 2 per cent, as the voltage and amperage generally fluctuate during the absorption measurements. Since the quality of the rays is as important as the intensity, in order to determine the erythema time, I believe that this time can be given only with an error of about plus or minus five per cent.

(3) The sphere gap always has to be corrected for altitude, sometimes for unusual air pressures. I found many cases where this had not been done, so that the operators thought they were using 200 kv. when they had only 190 or 183. I see great difficulties in making very exact measurements with a sphere gap under different conditions and do not claim that my sphere gap readings are without error in all cases.

(4) All measurements of normal intensity should be performed with the same copper filter, as there are differences in the thickness and in the physical and chemical composition of different sheets of copper.

(5) The main difficulty arises from the tubes. I always had to use the treat-

* Read at the Annual Meeting of the Radiological Society of North America, Detroit, December 8, 1922.

ment tube. Sometimes two or three tubes were at my disposal. As a result of my investigation of tubes in Europe and America I have found that new tubes which are very highly evacuated produce the same intensity. If two or three new tubes are measured and they show the same intensity, then we can assume that the normal output of the transformer was measured correctly. If only one old tube is available we cannot make any definite statement about the transformer, as with another tube a better output might result. Several times I found old tubes which were 12 to 15 per cent below normal. In one case a tube, which had been in operation more than 1000 hours was 22 per cent below normal. In another case I attempted to measure a tube which was so soft that we could not keep the milliamperage constant. When measuring the intensity approximately I found it to be 30 per cent below normal. The hardness of the rays of different tubes varies very little if it is measured through one millimeter of copper, but that is due to the fact that all soft rays are suppressed by the heavy filtration, and only the hardest rays pass through. If the full amount of hard rays is not produced, either by a poor tube or by a wrong wave form, the measurements will show chiefly a small intensity and only a slightly less hardness of the rays.

(6) As to the behavior of the tubes I wanted to find out how the tubes would stand the various conditions. There are different possibilities:

(a) The tube becomes soft spontaneously or after running a short time.

(b) The tubes are punctured by sparks along or across the tubes.

(c) The tube becomes overheated, so that the target sags somewhat, or so that the glass of the tube cracks.

All transformers which I measured are compared with the Victor transformer, which Dr. Schmitz and I use in the Mercy Hospital at Chicago. In order to compare other transformers with this one I call the intensity which it produces under normal conditions one hundred. Thus the intensity of other transformers under normal or different conditions can be given as the percentage of this intensity. (The 100 per cent intensity amounts to .23 e/sec.).

The Victor transformer is very reliable. For one whole year of service we have not had any serious trouble. The tubes operated by this transformer and a full wave rectification stand 200 kv., not more, as the tube would be punctured by sparks. The milliamperage may be five, six or eight, without direct danger to the tube, but we found it advisable to use only 5 ma., as one tube cracked from overheating. Some tubes did not stand 200 kv. They became soft after about 100 hours. Generally, as the Victor Company claims, 200 kv. is the practical limit if tubes are operated by this transformer and this rectifier.

Another Victor transformer showed exactly the same output.

A third Victor transformer showed an intensity of 85 per cent only with a new tube. In this case, trying two other tubes, the output was even 12 and 15 per cent below the first.

In all cases I measured such a hardness, that 42 per cent of the surface intensity would strike the depth of 10 cm. under the formerly named normal conditions.

The intensity produced by the fourth transformer was very low, 54 per cent, that is, 46 per cent below normal, under apparently the same conditions. With 720 ma. min. under normal conditions a very low erythema has been applied. In shifting the rectifier we were able to increase the intensity by only 15 per cent. Thus the filtration had to be lowered to ¾ mm. copper, in order to shorten the time of treatment. The depth dose was 40 per cent.

The Kelley Koett transformer, until two months ago, was combined with a half-wave rectifier. With this output the tubes stand only 3.5 to 4 ma. With a higher milliamperage they turn soft. The output of this apparatus is also a little low. With the two transformers first installed I measured it to be 69 and 73 per cent. Four other installations showed values between 80 and 90 per cent. The last two installations show 94 and 95 per cent. The hardness of the produced radiation is nearly normal, 42 per cent depth dose, sometimes 0.5 per cent less.

In all cases where I measured these transformers I found that the tubes stand more than 200 kv. Thus, I increased the kilovoltage to 210 and 220. There was no case where the tubes did not stand it. Under these improved conditions the intensity measured 10 to 20 per cent higher, so that in many cases the 100 per cent output was reached. The hardness, under these conditions, improved also, so that 43 and 44 per cent reach the depth of 10 cm.

Within the last two months a new rectifying disc is combined with these transformers, which sends the full wave to each tube. The advantage of this new outfit is that the tube no longer becomes soft if more than 4 or 5 ma. are sent through it. The output is increased; in all three cases I found 100 per cent. With this double wave rectification the tubes are also very safe. They could be operated with more than 200 kv. If two resistances of one-half million ohms are inserted into the secondary circuit, protecting the tubes against surges, the latter stands 220 kv. and more. With such a resistance the output drops about 2 per cent. But with 220 or 225 kv. the output is increased to 120 per cent, so that the time of treatment can be shortened considerably. In this case I measured a depth dose of 43 and 44 per cent.

The smaller 200 kv. Kelley-Koett transformer fitted with a full wave rectifying disc shows the same advantages, about 100 per cent output and protection of the tubes. They can work up to 215 kv. without sparks and then show an output and hardness much better than normal.

I standardized four Wappler transformers and found them all very easy on the tube, as they use large resistances in the secondary circuit and a full wave rectification. The tubes stand 5 to 6 ma. and more than 200 kv. I standardized some of these transformers with 220 kv. and did not see any fluctuation of the milliamperage. Regarding the normal intensity of these transformers I am not sure, as in one case I found 100 per cent intensity, in other cases I found it 6 and 29 per cent less than normal. In one case I found even less than that; but perhaps that was due to the tube, which was not perfect. In the best case with increased voltage the depth dose was 44 per cent and the output 120 per cent, that is, 20 per cent over normal.

The Standard transformer is quite extraordinary. It has a limited capacity, that is, if too high a milliamperage is taken the kilovoltage drops. I see three advantages of this property:

(1) There is no danger from touching the wires, because, if about 80 milliamperes are going through the body, the kilovoltage drops so low that it is no longer dangerous.

(2) It saves the tubes, as in a moment of gas development and of increased milliamperage through the tube the kilovoltage drops and lowers the gas development and the current.

(3) The surges are less dangerous, as with a higher kilovoltage the milliamperage is lower; with this transformer only, I found that heavy fluctuations in the secondary circuit, shown by inconstant milliamperage readings have been harmless for the tube.

Of course, these transformers cannot produce the full intensity. I always found it 18 to 30 per cent lower than the Victor or the Kelley Koett. The depth dose was 41 or 42 per cent. The tubes being very safe with these transformers stand about 215 kv. Under these conditions the full output in many cases is reached. The depth dose is 43 per cent.

In one case I measured an International transformer and found the

normal output to be 107 per cent. In this case the biological observations showed that a mild erythema would be produced with 312 ma. min. under normal conditions; and with 200 ma. min. when 0.5 mm. Cu was used.

In two cases I have had the opportunity of standardizing a Rieber outfit. Rieber combined a small transformer with a full wave rectification and two step-up transformers, which double the tension of certain waves and suppress other waves, so that the double peak value is reached. I found the radiation produced by these outfits very low, 71 and about 60 per cent, certainly due to irregularities in the voltage curve. But this outfit has the advantage of protecting the tubes against high frequency surges and allows them to be operated with about 240 kv. without being punctured. Under these conditions the normal intensity is nearly reached; the depth dose is only 40 per cent, but with the increased kilovoltage it goes up to 43 per cent.

I may now draw the first conclusion: Different types of transformers and rectifications show differences in the output and behavior of the tubes. But there are great differences also between different machines of the same type. If those differences could be eliminated by the factories it would be a great advancement.

Finally I wish to compare the German Neo-Intensiv apparatus, measured in Augustana Hospital at Chicago, with the American transformers. In this special case the apparatus is equipped with half wave rectification. This transformer is very easy on the tube and this is due to the large resistances in the secondary. It is operated with 230 kv., but 3.5 ma. only, as the half wave rectification does not permit a higher milliamperage. The normal output is 96 per cent.

I wish to call attention to the following advantage of this machine: In the primary circuit a continuously variable resistance (a sliding wire) is inserted. This makes it possible to overcome the steps between two settings of the autocontrol; that means that, not depending on primary fluctuations or the occasional value of the primary, we can choose each desired kilovoltage and keep it constant. This makes the practical application of the treatment more exact; but more especially it makes possible more exact measurements of intensity and hardness. I am glad to see doctors perform their own measurements of the constancy of the intensity or of the depth dose under different conditions, but generally difficulties and errors arise, as the kilovoltage changes between readings. In some cases, especially if the sphere gap alone is used, without a primary voltmeter, it is practically impossible to make an exact standardization or other measurements, as nobody knows what the exact kilovoltage is during the time of measurement.

I claim that a primary voltmeter is necessary, that a continuously changeable resistance in the primary besides the normal auto or rheostat control is advisable.

I should like to make some further suggestions as to the improvement of installations in this country. Sometimes I found the rectifying needle or disc not properly installed. In many cases it is impossible to change it. I think it would be better to make it adjustable so that when necessary it may be easily adjusted.

Another recommendation concerns the installation of the tube. The newest development in this direction is the separation of the tube from the patient by a wall with a window, or by a table or a leaden box with a hole. That is very advisable and desirable, from a material and a psychological standpoint, especially as the patient is absolutely protected against the high tension current, noxious gases, noise and undesirable x-radiation. I saw beautiful installations made by the Kelley-Koett factory and Rieber, where the tube was under a table or behind a wall; I saw the large leaden boxes containing the tubes, such as the Wappler and International companies use. In all these installations right angles, horizontal or verticular beams are preferred. I think in many cases this installation covers all requirements; but in some cases we have to contend with various and difficult conditions and need different angles. For instance, if the supraclavicular glands and the neck are to be treated, we can scarcely do it with these types of installation.

Another physical suggestion may be permitted: Many physical investigations concerning the intensity and the hardness call for a horizontal central beam. For instance, if we want to measure the intensity or the total absorption factor of the radiation with the electroscope, we need such a horizontal beam. We also need it if we want to take the spectrum with a spectograph. It would be very interesting to measure the temperature of the anti-cathode *by optical methods* under different conditions, and with different transformers. All this could be done better with a horizontal beam. I am sure that in the future more physical measurements will be performed than now; and the more numerous the conditions and the possibilities of producing x-rays become the more we need such physical investigations.

In three cases I measured 200 kv. transformers in the altitude of about 5000 and 6000 feet. Under these conditions the tubes can only be operated with 175, 170 or 165 kv. Of course, the intensity was very low, about 70 and 60 and 40 per cent. Therefore, a greater milliamperage had to be used, and a lower filtration of only 3/4 mm. Cu was advisable in order to treat a patient. The hardness under these conditions equals 39 per cent depth dose. The best and most economical way to produce 200 or 210 kv. in this altitude would be to use a 200 kv. transformer, combined with a 240 or a 280 kv. disc. Both terminals of the transformer have to be insulated by a large sheet of mica in order to prevent sparking between them.

If we consider all these facts we come to the conclusion that under the different conditions of producing x-rays and with the very different output of rays the possibilities of determining the used energy by a statement of the number of the milliampere minutes no longer exists for the comparison of transformers. I found physicians applying a low erythema with a weak transformer and a great number of milliampere minutes, under the impression that they were applying a heavy dose. If radiologists wish to compare the transformers or the doses then they need standardizing measurements made by a physicist or they should make their own measurements with standardized instruments. There are three instruments on the market:

(1) The German iontoquantimeter, standardized by Friedrich in a certain physical unit, which makes it possible to apply an exactly determined erythema dose.

(2) The ionizing chamber of Professor Duane, standardized in "e" units.

(3) My standardized electroscope may also be made use of by physicians for the purpose of standardizing and keeping a check on the output of their machines.

I am now trying to establish the electrostatic units by eliminating the differences which now exist between the measurements of Friedrich, Duane and myself. I hope after a short while we will have a standard physical unit which will enable one to compare intensities and energies independently of individual methods of measuring.

EDITORIAL

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Scientific Advance and Research

BLACKBIRD HILL overlooks the Missouri River. From its top one can see for miles down the river up which the first white man came. The hill bears this name in honor of the Chief of the Dakota Indians, whose body rests there upon the back of the powerful black stallion which carried him through many battles. Chief Blackbird was buried on this mount at the highest point on Blackbird Hill in accord with his dying request, so that he might be there, ready to see the first white man come up the Missouri River. Sure enough, four years later, Lewis and Clarke came up the river, sighted Blackbird Hill and found on its summit the burial mound of Chief Blackbird.

Chief Blackbird

From the Dakota Indians, over whom the chief had ruled, they obtained some of the salient facts about his life. He stood more than six feet in height, was broad of chest, erect and keen of eye. He loved peace, but ruled his people with a firm hand, every subject revering him as one who held the power of life and death in his hand. When Chief Blackbird fell asleep there was always some faithful Indian present to gently stroke the muscles of his tired legs and arms so that when he awoke he would feel physically powerful. When they awakened him they were always careful in arousing him, lest he be angered and they fall from his grace. Chief Blackbird always rode the finest horse owned by the tribe, sometimes on peaceful journeys, sometimes in warfare. Since he was by nature a lover of peace he waged war only when attacked, but when he fought he showed no quarter and was never defeated.

At last smallpox entered the camp of the Dakotas and large numbers of them died. Finally Chief Blackbird himself became sick with the disease, quickly weakened, died, and was buried on the crest of Blackbird Hill, as had been his request.

Abraham Lincoln

This hill has become a landmark because of its significance in the history of Nebraska in the latter part of the eighteenth century. A few miles down the Missouri River, within the domain formerly ruled by Chief Blackbird, another hill has become of great historical interest. On the crest of this hill stands a granite monument marking the spot where President Abraham Lincoln stood when he visited the Missouri Valley to locate the eastern terminus of the Union Pacific Railroad. Only sixty-seven years had passed between the death of Chief Blackbird and the visit of President Lincoln. The significance of that visit will not be fully realized by this generation. All that rail transportation means to the development of the great continent of North America is wrapped up in that hill hallowed by Abraham Lincoln's footprints.

When Chief Blackbird lived, transportation was carried on by means of packs on the back of the human footman. A little later the "prairie schooner" was drawn across the plains by oxen. Now every morning and every evening the aeroplane brings the mail to a landing field not far from where President Lincoln stood in 1867.

When Chief Blackbird lived the tepees were lighted by the flickering flame of the burning log. When the boy Lincoln was educating himself it was by the flickering light of the open fireplace. Now electric lights turn night into day, making study and travel at night as easy as when the sun is shining.

When Chief Blackbird lived, messages were carried by pages on foot; now a powerful wireless station, situated within the shadow of the monument erected in memory of President Lincoln's trip to Council Bluffs, sends messages to all parts of the North American continent.

The changes mentioned above have taken place in about one hundred and fifty years. It requires a vivid imagination to picture this kaleidoscopic image. Professor James Harvey Robinson, in his book, "The Mind in the Making," has expressed the same thought in the following words: (The italics are the author's own).

> "We have, however, first to create *an unprecedented attitude of mind to cope with unprecedented conditions and to utilize unprecedented knowledge.* * * * How are we to put ourselves in a position to come to think of things that we not only never thought of before, but are most reluctant to question? In short, how are we to rid ourselves of our fond prejudices and *open our minds?* * * * When we compare the discussions in the United States Senate in regard to the League of Nations with the consideration of a broken down car in a roadside garage, the contrast is shocking. The rural mechanic thinks scientifically; his only aim is to avail himself of his knowledge of the nature and workings of the car, with a view to making it run once more. The Senator, on the other hand, appears too often to have little idea of the nature and workings of nations, and he relies on rhetoric and appeals to vague fears and hopes or mere partisan animosity. The scientists have been busy for a century in revolutionizing the *practical* relation of nations. The ocean is no longer a barrier, as it was in Washington's day, but to all intents and purposes a smooth avenue closely connecting, rather than safely separating, the eastern and western continents. The Senator will nevertheless unblushingly appeal to policies of a century back, suitable, mayhap, in their day, but now become a warning rather than a guide. The garage man, on the contrary, takes his mechanism as he finds it and does not allow any mystic respect for the earlier forms of the gas engine to interfere with the needed adjustments."

It would appear that Professor Robinson has clearly outlined the tendency of the times toward scientific thinking. At the same time that this change in the thought of the general mind is taking place, a similar advance in the thought of the medical profession is taking place. With this change in

the profession itself has come an added respect of the public for the practice of medicine. Not further back than the seventeenth century the medical profession and its practices were held up to ridicule, as evidenced by Moliere's *La Malade Imaginaire*. This drama, written by a dying man in his last illness, is his most powerful thrust at the foolish practices which he felt only hastened his end.

It is a considerable change from this picture to that recently painted by the actions of Governor Smith of New York, who called distinguished representatives of the medical profession to help formulate plans for needed legislation in matters pertaining to the public health, a consultation which should result in New York state having a sane and sound policy in public health legislation.

Frederick Grant Banting

Recently, in our community, a young matron, beautiful in mind, in spirit and in body, the mother of small children, was stricken with diabetic coma and within a few hours was dead. She had not known that she was afflicted with diabetes. In the future such an untimely end to so beautiful and useful a life will be unnecessary because of the self-sacrificing, scientific effort of Dr. Frederick Grant Banting, who has shown us the way to secure insulin. This man, working as an assistant in physiology at Western University, London, Ontario, conceived the idea which carried on through toil and sacrifice resulted in the isolation of the life-saving product insulin. The research worker must be an idealist with his wagon hitched to the star which leads him on to success, but he must at the same time have cooperation from men in allied lines of endeavor upon whom he may be free to call for assistance. This happy combination was afforded at the University of Toronto under the leadership of Professor J. J. R. Macleod. Here the resources of the physiological laboratory, the department of pathological chemistry and the department of medicine all cooperated in bringing this valuable contribution to science to a successful end. Who can picture the numberless lives which will be saved to future generations by this painstaking effort on the part of Dr. Banting?

Not only in this particular instance, but in many others, the same spirit is manifest.

Walter Edward Dandy

Another illustration of the value of cooperation in medical research is that the ventriculography in the diagnosis and localization of brain tumors. One day Dr. W. E. Dandy saw an x-ray plate of the abdomen of a patient suffering from typhoid perforation and noticed that the gas which had escaped into the peritoneal cavity made the diaphragm much more plainly visible. This observation suggested to him the injection of air into the ventricles of the brain as an aid in localizing brain tumors. So valuable an aid has this method become that Dr. Dandy recently made the statement that he considered ventriculography the most valuable aid to brain surgery. His work has now made it possible to definitely localize a tumor in any portion of the brain, thus saving the lives of patients who were formerly doomed to certain death.

William Conrad Roentgen

In the field of radiology we have the illustrious example of the late Dr. Roentgen, whose recognition of x-rays has not only revolutionized medicine, but has completely changed chemistry and has contributed greatly to the advancement of other branches of science.

William David Coolidge

Floyd W. Parsons in the Saturday Evening Post, May 5th, in an article entitled "Pioneering Beyond the Rim," calls attention to the value of scientific research, and cites the contribution of Dr. W. D. Coolidge to scientific advance. Through the work of Dr. Coolidge a process for making ductile tungsten wire was found. This greatly widened the possibilities of illumination, and in turn made the Coolidge tube possible. The self-rectifying x-ray unit and present day deep therapy would have been impossible without the work of Dr. Coolidge.

Mention was recently made in these columns of the sacrifices which led to the prevention of yellow fever and typhoid fever, and the history of medicine is replete with illustrations of the most self-sacrificing devotion to research which has resulted in great common good, but only too often these sacrifices are apt to be forgotten in our enjoyment of the life given to us by them.

It is very gratifying that such men as Mr. Parsons, and such powerful publications as the Saturday Evening Post, should take up constructively a program looking to co-operative effort in scientific research, because with such forces at work success is eventually certain, as indeed it should be certain, the future of the nation and humanity considered.

No disagreement exists concerning either the value or the method first espoused by the Journal and now so completely sanctioned by Mr. Parsons, as will quickly be seen by reading the latest of his series on the relation of science to everyday life. There is probably room for serious discussion, however, concerning his suggestion that this cooperative effort should be conducted in a large laboratory exclusively under the control and direction of industry. This, presumably, because it is believed that such a plan will keep research closer to practical application to industry and give business supervision and immediate financial support to the undertaking.

Speaking broadly, no one will dispute Mr. Parson's statement that the educational institutions of the country are more or less out of touch with the needs of industry. But that is all the more reason for using all the laboratories and personnel maintained at public expense in such a way as will do much to cure the present deficiency in our educational system, and at the same time give to the younger generations contact with science in industry. Certainly such a method ought to combine effectively scientific methods with theoretical teaching in a practical manner which would unquestionably prove of enormous value to the individual, to industry, to the nation, and to the world at large.

While it must be conceded that scientific research is purely the product of individual ingenuity and perseverance, yet it has been so clearly demonstrated that helpful cooperation is productive of greater scientific achievement, that in the first insance mere quibbling over details should not be permitted to stand in the way of accomplishing such an important development in our scientific life.

Iowa State Radiological and Physiotherapy Society

AN ALL DAY meeting of one hundred and twenty-two doctors interested in radiology and physiotherapy was held at Ottumwa, Iowa, May 8th, 1923, which resulted in the formation of the Iowa State Radiological and Physiotherapy Society with the following officers elected:

President . . . . W. A. Johnson, M. D., *Dubuque, Ia.*
Vice-President . . A. L. Yocum, Jr., M. D., *Chariton, Ia.*
Secretary-Treasurer . . B. H. Sherman, M. D., *Dexter, Ia.*

Miles Bronson Titterington, M. D.

July 13, 1870 :: :: :: :: March 25, 1923

Once more the dread harvester has appeared, and with his practiced hand, hewed away a life precious to the x-ray world. It is to chronicle the passing of the second president of the Radiological Society, and a charter member, that the writer (who, perhaps, was closer to Dr. Titterington, than

any other radiologist), endeavors to make empty words pay the tribute of the heart. An ancient sage said "Language was made to *conceal* thought," and it not infrequently seems that this statement is true. All the words of grandeur, of beauty, of high sounding timbre, coupled as only a lexicographer could couple them, would mean but little to the stilled heart of Dr. Titterington. It is to be regretted that someone, somewhere, sometime, during Dr. Titterington's lifetime, could not have said some of these deserved complimentary things to him whilst his heart could feel and his brain could understand; this eulogy to his memory cannot delight any person whomsoever; to his family it recalls his virtues; to his friends it brings home their lack of outspoken appreciation during the brief hours upon earth, when it was possible to say "You *are* a good fellow."

Dr. Titterington has sat at the banquet table and has taken a silent part in the award of gold medals to his brother x-ray workers; he has helped to bestow honorary memberships upon the worthy; yet he went through life without so much as a scratch of a pen, or bauble of whatsoever nature that might be laid up as a memorial in the archives of his family, to remind them that he had presided over the destinies of the Radiological Society as its second president.

The writer well remembers the only comment made by Dr. Titterington upon the successful fruitition of the efforts of founding a new x-ray society. Several years had elapsed; war had come and had gone; and one day in a quiet hour, and over a restful cigar, Dr. Titterington remarked, after the business of the society had been discussed, "Well, old war-horse, we started something, didn't we?" That was the first and last comment upon the past, present and future of the wonderfully successful organization.

Generous to a fault, his hand was first to "dig" when a worthy project was proposed. When the Journal of the Society was suffering from the effects, as did everything, of war inflation, he was among the first to open his private purse that the Journal might live and "carry on."

Dr. Titterington wrote many articles of a practical nature which were presented at various roentgen ray society meetings, and published in the various journals, but he never took sufficient time to prepare in book form anything appertaining to the roentgen ray. His work was ever to the simplification of technique and toward the practical application of theory. Where many a less modest master, with such a large and varied experience extending over two decades, might have blossomed forth in book form, Dr Titterington was content to impart his knowledge in terse, sledge hammer "punches" that took little of printers ink, but bore weighty messages.

It was unusual to see him out of temper. Ever ready and willing to suborn his own pleasures to the will of the majority he found his satisfaction in enjoying the delights of others. His laboratory was ever open to all seekers after knowledge; he never saw a "stranger," in fact, no one could long be "strange" to the beaming eyes and winning smile of the grand old warrior who has gone to his reward. Providence was kind in leaving him a son, Paul F. Titterington, a physician and roentgenologist, who will carry on his work.

Miles Bronson Titterington was born in Rock Island County, Illinois, July 13, 1870. He graduated from the College of Physicians and Surgeons in St. Louis, Mo., and entered the practice of medicine in 1894. He wedded Miss Clara Webster of Alton, Illinois, on February 5, 1894, and to the union was born a son, Paul F., January 17, 1895.

Like most of the "old" x-ray workers, his first medical work was in general practice, gradually giving way to the roentgen ray as this latter grew into prominence. He held many hospital appointments in St. Louis, but resigned them the better to care for his extensive private laboratory work.

In February, 1921, whilst awaiting a "late" patient in his office, Dr. Titterington suffered a cerebral hemorrhage that put him into the hospital for a month. His recovery was marvellous, but to the practiced eyes of his old friends the "old" vim and vigor were missing. March 2, 1923, seized with an attack of appendicitis, and having to drive sixty miles through mud, where it was often necessary to dig out the auto, the old Spartan did his share of the labor, only to arrive in St. Louis with a ruptured appendix, which when operated gave way to insufficient kidney function, and that to a pleural effusion, which at the end of three weeks closed his eyes in final slumber after as courageous a battle as has even been fought from a sick bed.

Floral designs in plenty from sorrowing friends everywhere gave mute testimony to the esteem in which he had been held. Radiologists from many cities attended the funeral. In compliance with his wishes he was cremated, Tuesday, March 27, 1923, and thus passed into the wonderful adventure, Miles Bronson Titterington.

He was prominently identified with the Elks, Masonic Order and Shrine, the St. Louis City Roentgen Club, the American Roentgen Ray Society, and was a past president of the Radiological Society of North America. The radiologic world is the better for his having lived and toiled within the fold.

May his soul rest in peace.

F. S. O'Hara, M. D.

Program Mid-Annual Meeting

J. T. STEVENS, M. D., *Montclair, N. J.*—"The Treatment of Malignant Diseases of the Cervix and Uterus with New Higher Voltage Shorter Wave Length Roentgen Rays, Radium and Electrothermic Coagulation."

Discussion opened by HENRY SCHMITZ, M. D., *Chicago, Ill.;* H. H. BOWING, M. D., *Rochester, Minn.*

H. J. ULLMAN, M. D., *Santa Barbara, Calif.*—"X-ray Dosage: Standardization Versus Individual Adaptation."

Discussion opened by HENRY SCHMITZ, M. D., *Chicago, Ill.;* EDW. C. ERNST, M. D., *St. Louis, Mo.*

W. H. WALLACE, M. D., *Brooklyn, N. Y.*—"Delusions Illusions and Facts in Radiographic Examination of the Gastro-Intestinal Tract."

Discussion opened by W. W. DUKE, M. D., *Kansas City, Mo.*

ALBERT SOILAND, M. D., *Los Angeles, Calif.*—"Further Remarks on Protective Measures with Special Reference to High Voltages."

Discussion opened by J. T. STEVENS, M. D., *Montclair, N. J.;* B. H. ORNDOFF, M. D., *Chicago, Ill.*

AMEDEE GRANGER, M. D., *New Orleans, La.*—"Further Observations with the Author's Sphenoid Line and Position for Making Radiographs of the Paranasal Sinuses."

Discussion opened by FREDERICK H. RODENBAUGH, M. D., *San Francisco, Calif.;* W. W. WASSON, M. D., *Denver, Colo.*

IRVING S. INGBER, M. D., *San Francisco, Cal.*—"Papillomatous Growths of the Stomach; A Roentgenological Study."

Discussion opened by LLOYD BRYAN, M. D., *San Francisco, Calif.*

L. K. POYNTZ, M. D., *Portland, Ore.*—"The Treatment of Carcinoma of the Breast by the Roentgen Ray."

ROLLIN H. STEVENS, M. D., *and* HANS JARRE, M. D., *Detroit, Mich.*—"Treatment of Cancer of the Breast by Deep Radiation and Surgery—A Rational Method According to Present-day Knowledge."

Discussion opened by ALBERT SOILAND, M. D., *Los Angeles, Calif.;* EDW. C. ERNST, M. D., *St. Louis, Mo.*

HARRY SPIRO, M. D., *San Francisco, Calif.*—"Determination of the Quality of the Heart Muscle by Fluoroscopy."

W. W. WASSON, M. D., *Denver, Colo.*—"Sarcoma of the Bone with Report of Cases."

Discussion opened by M. J. HUBENY, M. D., *Chicago, Ill.;* W. E. CHAMBERLAIN, M. D., *San Francisco, Calif.*

MAXIMILIAN J. HUBENY, M. D., *Chicago, Ill.*—"Localization of Foreign Bodies in the Eye."

C. B. WARD, M. D., *Spokane, Wash.*—"Comments on German Methods of Deep Roentgen Therapy for Non-Malignant Lesions."

W. W. DUKE, M. D., *Kansas City, Mo.*—"Treatment of Splenomyelogenous Leukemia by Irradiation of the Chest; a Preliminary Repart."

H. H. BOWING, M. D., *Rochester, Minn.*—"Preoperative Radium Application in Early Carcinoma of the Cervix Uteri, with Case Reports."

Discussion opened by C. B. WARD, M. D., *Spokane, Wash.*

HENRY SCHMITZ, M. D., *Chicago, Ill.*—"Treatment of Latent X-ray Burns."

Discussion opened by A. W. ERSKINE, M. D., *Cedar Rapids, Iowa.*

L. T. LEWALD, M. D., *New York City.*—"Syphilis of the Stomach, Appearances Before and After Treatment."

Discussion opened by W. W. DUKE, M. D., *Kansas City, Mo.*

ALEXANDER H. PEACOCK, M. D., *and* J. T. DAWSON, M. D., *Seattle, Wash.*—"X-ray as a Vital Aid in Urological Surgery."

Discussion opened by W. B. BOWMAN, M. D., *Los Angeles, Calif.;* LEON T. LEWALD, M. D., *New York City.*

M. J. BURNHAM, M. D., *and* JNO. R. O'NEIL, M. D., *San Francisco, Calif.*—"Chorioma Discussion of Pathology of Lesion, Its Metastasis and Treatment."
Discussion opened by B. H. ORNDOFF, M. D., *Chicago, Ill.*

A. W. ERSKINE, M. D., *Cedar Rapids, Iowa.*—"A Further Study of Dessauer Charts."

Discussion opened by H. J. ULLMAN, M. D., *Santa Barbara, Calif.*

B. H. ORNDOFF, M. D., *Chicago, Ill.*—"Investigation of the Appendix in Connection with Lesions of the Gastro-Intestinal Tract."

B. C. CUSHWAY, M. D., *and* R. J. MAIER, M. D., *Chicago, Ill.*—"The Symptomatology and Radiological Findings in Chronic Appendicitis."

Discussion of papers by DRS. ORNDOFF, CUSHWAY *and* MAIER opened by O. H. MCCANDLESS, M. D., *Kansas City, Mo.*

PHILIP K. BROWN, M. D., *San Francisco, Calif.*—"Roentgenologic Differential Diagnosis of Cavities and Small Pneumothoraces."

Discussion opened by KENNON H. DUNHAM, M. D., *Cincinnati, Ohio;* W. W. WASSON, M. D., *Denver, Colo.*

D. L. WEBSTER, Ph. D., *Department of Physics, Leland Stanford Univ.*—"The Distribution of Energy in the Continuous X-Ray Spectrum."

ROBERT J. MAY, M. D., *Cleveland, Ohio.*—Title to be announced.

I. S. TROSTLER, M. D., *Chicago, Ill.*—An Important Malpractice Case Decision.

DEPARTMENT of TECHNIQUE

Three Suggestions on Protection of Deep Therapy Tubes

E. B. KNERR, M. D.
Kansas City, Mo.

IN OPERATING deep therapy apparatus any means tending to protect the tubes will doubtless appeal to the operator. With this thought in mind the writer offers the following suggestions:

(1) Placing of filters: In distributing the sheets of copper and aluminum filters beneath the tube first insert plate of photographic glass nearest the tube, then the copper sheet followed by a sheet of aluminum, and then such remaining filters as may be desired. A discarded glass negative may be cut to the desired size and serve as the glass plate. The filtering effect of photographic glass is about the same as an equal thickness of aluminum. The purpose of the glass plate placed between the tube and the metal filters is to insulate the tube from shortage and static by way of the metallic filters. The writer has known of two tubes being punctured because the aluminum filter had been placed too near the tube.

(2) To prevent overheating of the tube a blower is furnished with some types of apparatus. The writer has on some occasions observed this blower directing its blast across the top of the tube at great risk to the latter, because of the very uneven temperature produced in its walls. The blower should have its blast directed downward between the tube and lead-glass bowl on one side causing it to circulate about the tube and make its exit upward on the other side, thus insuring uniform cooling of the tube.

(3) The brilliancy of the target in operation is an index of its temperature and of the behavior of the tube. Any marked increase or decrease of the brightness of the anode under operation is a sure sign of trouble. A careful operator likes to have a clear view of the target and takes a frequent glance through the lead glass window at the anode and the reflection of the focal spot from the walls of the tube. But the anode under a 200 kv. stress at four or five milliamperes is too brilliant to look at directly with comfort and its glare is too confusing to permit its observation to be of any practical value.

This glare may be readily eliminated by viewing the anode and its tube reflections through a graduated photographic film attached to the lead glass window, and in the line of vision as the observer looks toward the tube. A convenient film may be prepared as follows: An eight by ten inch film, or larger if desired, is placed in a paper container and on this a succession of layers of aluminum or glass is so arranged that each heap is one layer of aluminum (or glass) thicker than the preceding one. The several heaps should be disposed about two inches apart, like a series of shallow steps. In other words, rule the paper container holding the sensitive film with a series of lines two inches apart across the face dividing it into five fields. Over the field at one end of the plate place nothing. Over the second field and the remainder of the plate place a sheet of aluminum or glass about a millimeter thick. Over the third field and the remainder of the plate place another sheet of same thickness, and so on for the remaining fields. Now expose the plate for one second at about a three-inch gap and 25 ma. Develop full time. When fixed, washed and dried, this film of graded densities, hung with its several fields horizontal, is to be fastened to the lead glass window in the operator's line of vision as he observes his tube. By a slight movement of the head the observer can readily view the glowing anode in any field of density of the graded film that he may desire, and judge of its temperature by the amount of light transmitted. He may also find a reflected image of the focal spot and judge somewhat of the punishment he is giving his tube by the density of the field necessary to absorb its half-light say, or to blot it out entirely.

ABSTRACTS and REVIEWS

Preparing a Paper for Publication. Editorial in Texas State J. Med., 18:541, March, 1923.

THIS, says the author, is no small task, or if it is there is most likely to be a seriously deficient manuscript. The writer states that he is not urging that medical men produce literary gems, but that they "write intelligently and in such English as will produce a minimum of embarrassment in educated company."

The trouble, says the author, is that medical men are busy men. They throw their papers together for reading, expecting to polish them a little in the reading and later to rewrite the paper, which seldom is done. Then comes the galley proof "with a more or less polite note from the editor and the incident is closed. He does not realize the grief he has caused the long suffering editor, who has to study his manuscript carefully, determine what it was he wanted to say, and then see that he says it, as nearly as possible in his own language and at the same time in reasonably good English. Considering the limited capabilities of the editor, that is no small task."

The writer goes on to quote from an article by Dr. Zinke of Cincinnati, who says in a recent publication: "To write a good paper you must first select the subject * * * the next step is to examine the literature * * * then to compare the experiences and studies of others with your own. This done, make your dispositions and write out in detail what you have to say * * * lastly, draw your conclusions.

"After the manuscript is completed put it aside for a week or two, but continue to think of the subject, making a note now and then as to what you would like to add or omit. At the end of this period read the manuscript a second time and you will be surprised to find the many changes, additions, omissions, and transpositions you will find it necessary to make. You may even marvel how it was possible for you to write as poorly as you did.

"Again the paper in its improved form is locked away for another reading at the end of a week or two; and when you read it for the third time, you will find words, phrases, and even sentences that may be changed to advantage to make the subject matter clearer, the organization more compact, the diction more forceful and pointed.

"The next and final rereading should be devoted to polishing the paper. Remove every superfluous word, phrase and sentence. See that your adjectives are properly selected, and correctly shaded, and that your language is pure, simple, effective, and inoffensive to those who may disagree with you.

"After you have thus labored to do your best with the manuscript, submit it for careful perusal to one who is a master (or nearly so) of the English language and ask him or her to point out further defects and shortcomings, especially with reference to the syntax, punctuation, paragraphing and diction."

"Fine!" sighs the Texas editor, and adds, "Let us give more heed to such matters. Some day we are going to have time enough to treat our editorials that way * * * when our contributors have done so. It requires little time to edit a carefully prepared manuscript."—And more time than one might think to edit a poorly written one.

The Scope of the Roentgenologist's Report. Charles D. Enfield, M.D., J.A.M.A., 80:999-1000, April 7, 1923.

THERE are two extremes found in roentgenologic reports, and as a rule both are equally bad and useless to the man receiving them. In one a bald recital of details is given, a word picture, very useful to another roentgenologist, but having no meaning to the clinician who is not a roentgenologist. The other extreme form presents the x ray diagnosis, perhaps in one sentence; it gives the roentgenologist's opinion, but not his reason for that opinion, which is far from satisfactory. Aside from this the roentgen ray seldom can establish a diagnosis by itself, and so this form of report is, if anything, worse than the other one.

Another type of report simply states that no evidence of disease was found and makes no report of findings that might possibly have a bearing on the case, at times there may be indications of some unsuspected pathology which will be entirely missed unless report of them is given the clinician.

The author summarizes his paper thus: "It would seem that the ideal roentgen ray report should present a careful and accurate description of the picture seen. It should offer whatever explanation of variations from the normay may be conservatively given on a basis of established roentgen pathology. It should give, when this can be conservatively done, an estimate of the activity and present importance of the lesions; such estimate, however, to be derived entirely from the roentgen signs. It should place in the hands of the clinician all the information the roentgenologist has been able to obtain by his peculiar method of examination, and should offer it in such form as will most facilitate the correlation of the roentgen and clinical evidence."

A Complete Examination of the Chest. James A. Honeij, M.D., Am. J. Roentgenol., 10:247, March, 1923.

DR. HONEIJ says that the simplest cases are frequently the most difficult of interpretation and that to his sense of touch and hearing the clinician should add the sense of sight, which he may do by using the fluoroscopic and radiographic methods now at his disposal.

New Growths Within the Chest: X-ray Diagnosis. Samuel B. Childs, M.D., Am. J. Roentgenol., 10:175-182, March, 1923.

THE CHANGES characteristic of new growths and also those associated with certain inflammatory conditions are first reviewed, the growths of the chest being classified under those of the mediastinum and of the lungs. Hodgkin's disease, lymphosarcoma, intrathoracic thyroid, enlarged thymus, cysts, cold abscess, aneurism, tuberculous glands and the primary and metastatic malignancies are discussed together with the differentiation of benign and malignant growths.

The author's summary reads as follows: "The x-ray furnishes valuable evidence in all new growths within the chest, and in some of these conditions a positive diagnosis can be made from its use alone. It is considered, however, that in all cases of new growths, the x-ray should be combined with the clinical and laboratory evidence before a positive diagnosis is made. Primary carcinoma of the lung presents, generally, a fairly definite group of symptoms as well as a rather typical x-ray picture, and, although it is not common, yet it occurs sufficiently often for the clinician and the roentgenologist to bear the possibility of its existence in mind, when the findings in a given case are not satisfactorily accounted for by the diseases ordinarily found in the lungs. When the combined evidence is before us, mistakes in this diagnosis will be greatly lessened."

New Growths Within the Chest. J. N. Hall, M.D., Am. J. Roentgenol., 10:182-187, March, 1923.

DIAGNOSIS of malignant diseases within the chest the author believes to be possible in the majority of cases where it exists. These malignant diseases may involve the lungs, bronchi, pleurae, mediastinal glands, thymus, thyroid and the esophagus. Teratoma is included also.

Increase of malignant disease of the lungs and bronchi has occurred lately and the author ventures the opinion that the influenza epidemic has had its part in this, and he says, "Doubtless, a chronic inflammatory lesion always precedes the malignant growth."

The etiology, localization, symptoms, physical signs, clinical and laboratory diagnosis, and complications of new growths of the lungs and bronchi occupies most of the article. Malignancies of the pleurae and mediastinum and differentiation of these latter from tuberculosis are discussed throughout one page.

"In conclusion we should state that metastasis of malignant tumors to the chest is so common that roentgenological examination of the thorax before operation of such cases is as necessary as the customary palpation of the liver for metastatic nodules. We have said little of treatment. Unless the growth can be checked in some degree by the use of the x-ray, we can offer but little hope."

Pleural Effusions. Willis H. Watson, M.D., Northwest Med., 22:119-122, April, 1923.

"WHEN a patient complains that breathing is embarrassed when lying on one side or the other and the respirations are accelerated, one should suspect fluid within the chest. Radiographic examination of the chest should be a routine procedure before all operations and in the presence of any post-operative complications should be repeated. * * *

"Fluoroscopic examination in the upright position is the one of choice, as it reveals the fluid level, and when the position of the body is inclined to the right or left the same fluid level is observed. Fluoroscopic or radiographic findings made in the prone position are misleading, and the shadow produced by a small amount of the fluid is so dif-

fuse that it may be overlooked, whereas a large amount of fluid obscures other pathology in the chest.

"However, it is of some aid when comparing it with the findings of the radiograph made in the upright position. Obliteration of portions of the pleural sac with walled off areas of fluid give rise to a different picture."

Non-Tuberculous Pulmonary Abscess. Wyman Whittemore, M.D., Bost. M.&S.J., 188:497, April, 1923.

DR. WHITTEMORE has this to say of x-ray examination in these cases: "The x-ray may be said to be the most important examination, for in many instances it makes the diagnosis, and in all cases it localizes the process more accurately than any other examination, this localization being of the greatest value to the surgeon in contemplating operation."

The Effect of Small Doses of Roentgen Rays in Certain Forms of Impaired Hearing. D. C. Jarvis, M. D., Am. J. Roentgenol., 10:201-202, March, 1923.

FROM CERTAIN striking experiences in his practice the author has been led to the following conclusions: "Small doses of roentgen rays are a valuable aid in treating aural disease. They are most valuable in cases disclosing a prominent throat element. It would seem that results are obtained by the roentgen rays influencing the bacterial content of the throat. Their influence is most marked on tinnitus aurium, relief following soon after the treatment."

Witherbee's tonsil technique was used in giving treatment to those patients reported in this paper.

Treatment of Defective Hearing by Small Doses of X-rays. John McCoy, M. D., Am. J. Roentgenol., 10:203, March, 1923.

THE TYPES of cases and the conditions causing defective hearing were as follows:

"Otitis Media Catarrhalis Chronica (O.M.C.C.) otherwise known as chronic dry catarrh. Otitis Media Purulenta Chronica (O.M.P.C.) Otitis Media Purulenta Residua (O.M.P.-R.)), and Otosclerosis."

O.M.C.C.	Greatly improved	9
	Slightly improved	19
	Not improved	7
O.M.P.C.	Greatly improved	0
	Slightly improved	2
	Not improved	0
O.M.P.R.	Greatly improved	1
	Slightly improved	1
	Not improved	0
Otosclerosis	Greatly improved	2
	Slightly improved	2
	Not improved	2

The method and technique is as follows: "The patient is seated 30 inches from the taget and has the x-rays applied in turn to the right ear, left ear, the occiput, and the open mouth, in a direction toward the pituitary gland. A 110 volt current is used with a four inch spark gap and from five to ten ma. The exposure lasts from ten to thirty seconds laterally, from ten to twenty seconds posteriorly and from five to fifteen seconds anteriorly. An opaque shield with a perforation three inches in diameter is used laterally. The shield is held in front of the eyes for the anterior exposure. The treatments are given two or three times weekly for three to six weeks."

In conclusion the author states that the treatment is not harmful and is often beneficial, therefore is worth a trial.

Correct Radiographic Technique and Interpretation in Its Relation to the Elimination of Oral Pathologic Foci. Frederick F. Molt, D.D.S., Dental Cosmos, 65:341-346, April, 1923.

THIS WRITER urges medical assistance of the highest order in the realm of dentistry. Simpson's characterization of many x-ray laboratories is given—"radiographic shooting galleries—so much a shot, hit or miss," and his characterization of the sort of interpreter too often found in these laboratories—" a histopathologic clairvoyant." Between the faddist and the ultraconservative (too frequently the latter is merely selfishly reluctant to accept professional advances) there is much room for the exercise of sane radiography.

A standardized technique is greatly needed. The most desirable radiographic film is one made with little penetration, three to three and one-half inches back-up being enough in most cases, two inches in edentulous mouths. The McCormack technique making exposures at a target distance of from 24 inches in the anterior to 36 or 40 inches in the posterior, the light thrown by the Coolidge filament being utilized for focusing, is a particularly desirable technique to use with upper molar exposures "inasmuch as through it the relation of root apices to antrum floor is shown and the malar shadow thrown out of practically all radiograms. Using 20 ma. the exposure should vary from three to eight seconds in the anterior and eight to fifteen seconds in the posterior, depending on the film used. The resultant radiogram is thin and 'contrasty' but not under-exposed."

In many cases a single radiogram is not enough, but exposures must be made from many angles, and, of course, diagnosis cannot be made from the radiogram alone, though often the worst possible conditions remain undisclosed until the x-ray is resorted to.

The man attempting oral diagnosis should have the benefit of clinical experience in general practice and that coming from observation of oral surgery. He should from his radiographic study be able to recognize such variations "as mark the anterior palatine foramen and fossa and median suture; the nasal fossae; the canine fossae; the antrum; and the posterior palatine foramen; and the shadows of the malar and coronoid processes in the maxillae; the incisive fossae; mental foramen; inferior dental canal and mylohyoid grooves in the mandible."

An accepted nomenclature is a great need at present and several suggestions are made by the writer. *Radiolucent* and *radiopaque* are preferable to "rarefied areas." The latter presupposes bone destruction.

"*Periodontitis, alveolitis, granuloma, abscess, cyst*, are logical and easily understood when designating progressive pathologic changes in the area around the tooth root *Hypoplasia* and *hyperlasia* are preferable to "absorption" and "hypercementosis", also "exostosis". *Osteogenesis* is preferable to "regenerating bone."

If radiolucence is found in areas having a past history of pathology, and the requisite period for osteogenesis has passed, then residual infection may justly be suspected.

Radium in Intra-Oral Cancer. Douglas Quick, M.D., Urologic and Cutaneous Rev., 27:219 224, April, 1923.

THE AUTHOR'S summary is as follows: "In the treatment of intra-oral carcinoma we believe two distinct problems are presented: (1) Treatment of the primary growth. (2) Treatment of the cervical lymph nodes.

"In the treatment of the primary growth, radium alone is the agent of choice. Technique must be varied to suit the needs of the different groups of cases and of the individual case. An appraisal of the case should be made when treatment is instituted, and the plan of treatment varied, depending upon whether a complete regression or only palliative relief can be anticipated. We believe that this procedure offers a hope for complete regression in a larger number of cases than does surgical removal. We also believe that it offers a vast amount of palliative relief to that large group of cases otherwise doomed to opiates alone.

"In the treatment of cervical lymph nodes we believe that the combination of radium and conservative surgery eliminates a large number of needless operations, and in those cases where extension of the disease to the neck is demonstrable there is a better chance of eradicating it than by the surgical procedure alone.

"In many of the inoperable necks it offers a considerable measure of palliative relief.

"Finally, we believe that this method of treatment of intra-oral carcinoma will ultimately tend to increase the confidence of the public in general so that patients with suspicious lesions will present themselves early in the course of their disease for advice and treatment."

A Clinical and Pathological Study of Tonsils Subjected to X-ray. Charles R. C. Borden, M.D., Boston M. & S. J., 188:493-497, April 5, 1923.

A TOTAL of fourteen cases was radiated, the tonsils afterwards being resected. Dr. Paul F. Butler radiated the tonsils according to the Witherbee technique. Dr. Frank B. Mallory prepared and studied microscopically the resected tonsils, and Dr. Frank L. Richardson administered the anesthetic for operation. The conclusions drawn from this study are as follows:

"Fourteen cases of diseased tonsils x-rayed from one to four times failed to show any clinical or pathological changes as a result of the radiation except as follows:

"During the times the radiations were being given, many of the tonsils seemed to be smaller and more normal in appearance, but when subsequently removed by dissection no real change in size appeared to have taken place.

"After radiation many of the tonsils appeared to be normal in size and color, but at the time of the operation a number of them were found to be filled with pus or cheesy debris. I regard this to be the most important information gained from our work in this series of cases.

"As a method of reducing bleeding and assisting dissection at the time of operation radiation is useful.

"By diminishing over-secretion from the mucous surfaces of the throat it decidedly decreases the possibility of postoperative pneumonia or lung abscess following throat operations.

"In cases where diseased tonsils may be justly suspected of producing secondary infections in the joints, heart, kidney or other important organs x-ray radiations are inadequate."

The histological picture in all of the tonsils was found to be that of a mild inflammatory process with hyperplasia of the lymphoid elements.

Although the author regards the method as a valuable preoperative adjunct he believes it is impractical, as yet, owing to several facts, namely, the danger attendant upon any but expert radiation, the cost of the apparatus, and the psychological factor involved, that is, patients cannot see the use of radiation *plus* operation.

To Prevent Loss of Radium. B. B. Kirklin, M.D., Hospital Management, 15:41, March, 1923.

THE FOLLOWING suggestions were adopted by the Home Hospital at Muncie, Indiana: Only graduate nurses, especially the floor supervisor, are permitted to remove and handle radium, and such individual is responsible for seeing that the radium is replaced in the safe. When the radium is applied to a patient a tag printed in red letters bearing the legend "Radium, Do Not Destroy," is tied to the end of a string fastened to the radium. A red tray is provided, and only one red tray allowed in the hospital, this tray is used for radium or radium dressings and instructions are given that it is never to be emptied without first being sure that it contains no radium.

Report of the Safety Committee Presented at the Los Angeles Meeting of the American Roentgen Ray Society. Am. J. Roentgenol., 10:246, March, 1923.

THE DANGER from high tension shock is the phase of the subject which this report covers. The report is submitted by Drs. G. W. Holmes, P. M. Hickey, W. D. Coolidge and H. K. Pancoast and reads as follows:

1. X-ray equipment should not be installed or operated in low-ceiling rooms with overhead piping, or in damp or poorly ventilated rooms.

2. Floors should be covered with cork or other insulating material.

3. Footswitches should not be used in any radiographic work.

4. All diagnostic operating switches should automatically and positively open when released.

5. Double scale milliammeters should be eliminated.

6. Two milliammeters in series should be used in treatment.

7. All x-ray apparatus should be equipped with quick acting circuit breakers, preferably of double pole type. These should open with certainty on a 20 per cent overload. Circuit breakers should be tested at least once a month and a permanent record kept of these tests. Properly rated fuses should be used in addition to circuit breakers.

8. Where overhead high tension lines are used they should be of metal tubing not less than one-half inch in diameter. They should be firmly mounted and extend to the transformer or rectifier terminals.

9. High tension reel wire should be of fine braided enameled copper without cloth covering, strong enough to stand a pull of not less than 50 pounds weight.

10. High tension reels should be firmly mounted and have proper winding guides to prevent catching when winding, and sufficient tension to wind up against a pull of one pound weight.

11. Vertical and horizontal fluoroscopes should be so enclosed by insulating materials as to prevent operator, patient or assistants from approaching within sparking distance of any part of the high tension system. Metal screens should not be used if the fluoroscopic table permits the use of a tube over the patient.

12. In every installation the operating switch should be so placed that a full and unobstructed view is had of the high tension line to be used. If lead glass windows are provided they should be large enough to insure such a view.

13. All tables used for treatment with the patient between the tube and the table should be made of insulating material, unless the tube and terminals are enclosed in a permanent grounded case. No spring mattresses should be allowed.

14. Tables used for radiographic and fluoroscopic work should be of insulating material when practical, and the handles of all switches and diaphragm controls should be of such material.

15. When tubes in more than one room or booth are to be operated from the same transformer, provision should be made so as to make impossible simultaneous operation or closure by any one not in direct charge of the tube or line used. This may readily be accomplished by suitable interlocking switches or otherwise.

16. All bedside or portable outfits should have their high tension lines so placed that they permit of doing bedside work without having their wires come nearer to the patient than the tube terminals.

17. No treatment apparatus should permit any part of the high tension system to come closer to the patient than double the operating spark-gap, unless protected by a suitable insulator.

18. Permanently placed grounded metal screens between the tube and the patient are permissible and advised where the spark-gap exceeds ten inches.

19. Machines for high voltage therapy should be so designed that

their milliamperage on a short arch discharge is not more than 50 ma.

"In conclusion, the committee recommends that in view of the constant and rapid changes taking place, both in the application of x-ray and in the manufacture of apparatus, a board be appointed to which questions having to do with the dangers incident to the use of radiation of short wave-lengths and the apparatus used to produce them can be referred. It has seemed to this committee that this subject is too large and is changing too rapidly to be covered in any one report, and that it would be better to take up individual problems as they arise."

Possible Dangers in Connection with the Use of X-rays and How to Avoid Them. John S. Shearer, Ph. D., Am. J. Roentgenol, 10:240-245, March, 1923.

THE NATURE of accidents reported is classified under 19 heads in this paper, written by the late Professor Shearer. In the abstract the nature of the accident is printed in italics and the remedy given is printed in Roman type following.

1. "*Accidental closure of low tension switch.*—Would not occur if it were necessary to perform two voluntary acts each time an exposure is made and all switches were self-opening. Thus a latch device that has to be held out before a switch can be closed, and a spring opening the switch when the hand is removed would make closure deliberate in all cases. Push button switches should have a stop making pressure at two points necessary for operation.

2. "*Short circuit of foot switch or locking in position.*—No foot switches should lock closed, or have such weak springs as will permit a slight pressure to close them. All breaks should give a clearance large enough to avoid possibility of arc or accidental bridging.

3. "*Leaving low tension switch closed and attempting to adjust tube or reels.*—Would not happen if the suggestions in No. 1 were adopted and the operator was obliged to stand where there is full view of the tube, patient and high tension line. Lead glass windows if used should be large enough to permit such a complete view.

4. "*Coolidge filament wires hanging too low.*—If overhead tubing is used Coolidge wires should be drawn inside of one tube and reels should be firmly supported.

5. "*Breaking of reel wire and the end attached to the tube falling on the patient.*—The flimsy reel wire, often only common tinsel, so commonly used, is inexcusable. A braided tube over a twisted center made up of very fine enameled copper wire is at once strong and flexible.

6. "*Attempting to set a double scale milliammeter when operating switch is closed.*—No double scale milliammeters should be permitted. For treatment a 0 to 10, for radiography a 0 to 100 scale covers all needs. This would avoid danger of changing during operation and of treating with an improper scale setting.

7. "*Failure of high tension insulators.*—A noteworthy example of this was seen where a hard rubber insulator passed through a lead box on a vertical fluoroscope. The fluoroscope was mounted on wooden castors. The lead was left sharp edged around the rubber and by corona action finally broke through. The discharge passed from the lead box to the metal diaphragm handle to the observer and thence to the floor. Micanite tubes, or hard rubber tubes with a thin inside metal tube would prevent such an accident.

8. "*Crossing on high and low tension lines.*—This means improper installation or loose wires hanging where contact is possible.

9. "*Failure of insulation of low tension circuit.*—A switch opening only one side of the power line was opened under conditions giving a heavy surge. This broke through the primary insulation in such a way as to leave a small primary current still passing. All circuit breakers and switches should break both lines, that is, be of the double pole type.

10. "*Bringing the tube too close to the patient.*—No arrangement of ordinary apparatus will protect a patient from a careless operator.

11. "*Leaving wires too close to the patient.*—Same as No. 10. Reels should always keep wires taut.

12. "*Spark-over due to surge.*—This may exceed ordinary operating or spark-gap voltage.

13. "*Failure to shift high tension switch to proper side before closing primary.*—Only one connection should be possible at a time and the operator should be able to close the circuit only when in a given position.

14. "*Breaking of overhead line.*—Poor construction to be avoided.

15. "*Attempting to measure spark-gap with a ruler when power is on.*—A careless procedure. A well insulated handle and a proper scale should be provided.

16. "*Discharge to diaphragm control due to slack reel wire.*—Poor reels or worn covering. See reel wire above.

17. "*Spark in primary insulation cutting out part of the control and thus causing unusually high voltage.*—May give a much greater voltage than intended.

18. "*Unusual spark-over due to failure to close filament circuit on a resistance controlled machine.*—On large machines the Coolidge filament should light when the motor switch is closed.

19. "*Contact with unused connectors or reels, sometimes in rooms where one has no information as to whether high tension is on or not, viz., fluoroscopic room separate from the radiographic room and operated by a transformer in the latter.*—A dangerous practice."

This list does not exhaust the possibiltiies. Some of the accidents here listed were fatal and all were painful. The author adds that the practice of making dental radiographs in the ordinary dental chair is a dangerous one. Wooden chairs well insulated should be used.

The prevalent idea that if grounds enough are provided everything else may be neglected is a much mistaken one. The grounding may even be a source of danger, e. g., if one touches a high tension line.

The following testing devices are given: "What regions are in danger of spark-over to the operator or patient? Place a metal plate or water in a metal pail on the floor. Insulate a milliammeter and connect one terminal to the plate or the water, fasten a piece of flexible wire to a dry stick about three or four feet long and approach it to various parts of the apparatus when in operation. The spark distance and the milliampere reading will give a fairly good idea of the danger if the body replaced the wire.

"Test overhead systems by hanging a weight on the middle portion considerably in excess of the pull of the reels when fully extended.

"Milliammeters in series should give identical readings. This test is easily made.

"Line leakage in therapy can be tested by putting one milliammeter close to the tube and the other close to the transformer. When a meter near the transformer reads 5 ma. and 0.5 ma. less near the tube, the error is considerable. Leakage is always greater at higher voltages."

A Method for the Opaque Meal Examination of the Stomach. S. Gilbert Scott, M.R.C.S., L.R.C.P., Arch. Radiol. & Electroth., 27: 304-315, March, 1923.

THE AUTHOR believes that the time will come when every gastric lesion of organic nature may be detected by the opaque meal examination. Practical experience and extremely careful observation are required to make this at all possible, and the radiologist must always remember that often the decision for or against operation de-

pends upon his diagnosis, and unless the evidence is unmistakable it is his duty to state that it is weak or uncertain or incomplete.

The methods in use in America, on the continent and in England are compared. All methods have been used by the author, but he prefers his present technique to any other one, as for the past three years he has secured a correct diagnosis in 94 per cent of cases where it has been tried.

Systematic, radioscopic palpation, inch by inch, is done, and this must be done rapidly and accurately, which practice will make possible. The ordinary "prodding" called palpation will not do.

Clinical history too often is unreliable and misguiding and in general it is not necessary to the radiologist who is better off without it, as his judgments will then be independently made. Radiographs are of only secondary value, small ulcers may be missed thereby. Radioscopic palpation will reveal any lesion that a radiograph will reveal. If the radiologist cannot be present at operations, then report sheets made out by the surgeon and giving the particulars of the condition found should be provided the radiologist, so that the accuracy of the radiological diagnosis in each case may be checked up by him. If this is not done he will miss many a thing that would increase his knowledge and power.

Thirty-six to forty-eight hours before examination the patient is given castor oil or some other vegetable purgative and is put on a light diet, but not starved. Unusual hunger has a definite reflex effect on the behavior of the stomach.

Barium sulphate is difficult to administer in a palatable form and the author uses a barium cream made up in three thicknesses, the formula for which is as follows:

No. 1—*Thick Flavoured*

Barium sulphate	10 ozs.
Saccharin	2 grains
Vanillin	5 grains
Gum tragacanth	100 grains
Distilled water to	20 ozs.

No. 2—*Thin Flavoured*

Barium sulphate	10 ozs.
Saccharin	2 grains
Vanillin	5 grains
Gum tragacanth	60 grains
Distilled water to	20 ozs.

No. 3—*Thin Unflavoured*

Barium sulphate	10 ozs.
Gum tragacanth	60 grains
Distilled water to	20 ozs.

The gum and barium are mixed to a powder and the water gradually added and all is then sterilized. The cream is better if made by a chemist and it may be used for injections into the sinuses also, as it is sterilized.

The cream throws a dense homogeneous shadow and readily penetrates into every crook and crevice. Three to four ounces are first given, and followed by six ounces or more if necessary. The rate of emptying is influenced by so many unknown factors that it is regarded as of little diagnostic value. Mechanical narrowing of the pylorus or duodenum sufficient to cause delay should easily be detected at the first examination. The double meal method may lead to error and is not in favor with this author, and if it is used extreme caution must be observed for "the evidence of a gastric ulcer may depend upon a very small fleck lying close to the stomach shadow. If an opaque meal, or even bismuth mixture has to be given to the patient some hours previously, it is quite possible for a small quantity of this to be seen lying apparently in the stomach area, resembling an ulcer crater, although actually it is in the small or even in the large intestine."

Concentration of the radiologist upon the task at hand is very important and it must be aided by perfect organization and comfort. Outside disturbances, noise, delay—all should be eliminated. Comfort assists concentration and is well worth securing, for it saves mental fatigue and wasted nervous energy. An upright diascope will enable the radiologist to sit in comfort and to use both hands without being cramped and also to get at the patient, moving him in any direction desired without any word of command being necessary.

Expedition and accuracy will be gained by systematic examination. A definite order of routine should be followed in all fluoroscopic work and should be persisted in since, for instance, the presence of a chronic gastric ulcer does not exclude the possibility of a dunodenal ulcer.

Apparatus should be simple. The fluorescent screen for gastric examinations should not be larger than eight by ten inches and it should be the best on the market. The patient must have full support to lean on, a metal cylinder eight inches long fixed to the face of the diaphragm is used by the author. There must be enough space between the back of the screen and the front of the patient for the hands to palpate and there should be provision for placing a cassette near at hand so that a radiograph can be easily and quickly taken if desired.

For protection, thick lead around the tube, an extra thick lead for the face holding the diaphragm, and diaphragm shutters of lead and iron should be used. Two sheets of the best lead glass should be placed over the screen and specially protected gloves, light and supple, should be used. The patient should be protected by a filter of aluminum over the diaphragm. The distance between the tube and the screen should not be less than thirty inches. Minimum current should be used and sufficient earthing employed. Before new apparatus is used it should be tested with a fluoroscopic screen or otherwise. If these precautions and measures are used the method is perfectly safe.

Rough handling may set up spasm of the stomach and close the pylorus, therefore palpation must be gentle and should be done with the flat of the fingers, not the tips. Both hands should be trained to work in conjunction.

As to position of the patient, with a properly arranged diascope a much better view is usually obtained with the patient standing, but without this diascope both upright and horizontal positions must be employed, the patient lying on the right side to permit a view of the pylorus and the duodenum, though the degree varies with different individuals. In drinking the cream the patient should hold the cup in the left hand to avoid contact of elbow and screen. "Without manipulation the cardiac end of the stomach cannot be distended to the same extent as the lower segment, no matter what quantity of the meal is given.

Minute directions for palpation are given. Patience and practice will prove the diagnostic value of the method and the author is of the belief that the value of radioscopy in gastric work will soon prove itself greater than that of radiography.

Duodenal Ulcer. Maurice F. Dwyer, M.D., Northwest Med., 22:122-126, April, 1923.

DIAGNOSIS depends upon clinical history, carefully obtained, and upon the proper interpretation of x-ray findings. The author in his summary says: "With a typical history of ulcer it is possible for the clinician alone to diagnose accurately approximately 80 per cent of duodenal ulcers. Fourteen of the ulcers in this series would not have received a definite diagnosis had it not been for the x-ray findings. The clinical diagnosis in those presenting a typical history was fortified by confirmatory x-ray evidence. Persistent deformity of the duodenal bulb found on re-examination, after obtaining full physiologic effects of an antispasmodic, is the most important sign in the diagnosis of duodenal ulcer. This statement was proved at operation to be correct in 93.5 per cent of cases diagnosed duodenal ulcer by the roentgenologist. The value of the negative x-ray

findings in excluding ulcer was even higher. We have record of only one ulcer not diagnosed by the x-ray which was found in approximately three hundred operated cases in which the duodenum was examined. All patients complaining of gastric symptoms should receive a routine clinical examination before being referred for roentgen study, as 88 per cent of such patients have lesions other than those of the stomach and duodenum. Roentgen diagnosis is a branch of internal medicine. The roentgenologist and clinician must work in unison. Each is indispensible to the other in arriving at the ultimate diagnosis."

The Clinical Importance of the Chronic Changes in the Appendix which are Discovered by the Roentgen Ray. Franklin W. White, M.D., Boston M. & S. J., 188:587-583, April 19, 1923.

WHAT are the signs of chronic appendicitis and how important are they to the individual? The author states that with the rare exception of tuberculosis there are no chronic inflammations of the appendix, though there may be chronic changes which may cause functional changes.

The direct x-ray signs are tenderness, fixation, kinking, changes of shape, abnormal position, lack of filling, slow emptying, beading, also adhesions in the ileocecal region. Indirect signs are pyloric spasm, gastric residues and ileal stasis.

At six hours the barium meal is scattered in the coils of the ilium and the appendix cannot easily be seen. Twelve hours and onward from that period are the best periods to make the examination. Sometimes the best time is found to be even 48 hours afterwards. Fluoroscopic examination is made with the patient lying on his back.

The value of the x-ray regarding tenderness consists in sharply localizing the pain. Though most normal appendices are not tender, the tenderness is subjective and should not be regarded as absolutely indicative of disease, adhesions, etc., must be considered along with the tenderness.

As to filling authorities differ. George says an appendix which does not fill is pathological, while Skinner says an adult appendix which does fill is pathological. Cohen says the appendix may fill and empty several times during the passage of an opaque meal. Partial filling may give only a faint outline. Though nearly all pathologists agree that obliteration indicates disease the author would not take it by itself as a positive sign of pathology.

The various reports concerning the results from different meals the author regards as due to a varying care in examination more than to any difference in the form of meal used.

Filling may be irregular, interrupted, beaded or segmental, or may show fecal masses. Beading, the author believes, may result from haustration or the drying out of the contents of the appendix, and is probably due to purely physical causes. Filling around fecal masses, showing like peas in a pod, is usually indicative of disease.

The normal appendix will empty in from 24 to 36 hours. If it has not emptied soon after 36 hours or soon after the cecum is empty then pathology is suspected.

Fixation or kinking must be permanent to have any bearing in diagnosis. Kinking and angulation also is usually due to adhesions, narrowing, scar tissue, and obliterative changes.

Large size alone is not indicative of anything abnormal, as the size varies with muscular tone and personality. Any change of form must be constant to be regarded as of any diagnostic significance.

The position of the organ may vary greatly if it is free, as it is very movable. It often is found five or six inches from McBurney's point.

Of ileal stasis the author has this to say: "In weak, sick or old people there is often delay all along the line, the stomach, ileum and colon. Don't stress ileal stasis in such cases as these; in the atonic, ptotic cases are made most of the mistaken diagnoses."

Pyloric and duodenal spasm and gastric residues are not regarded by the author as reliable diagnostic signs of chronic changes in the appendix and are only met with about one time in 12 or 155. Incompetent ileocecal sphincter has even less diagnostic value.

X-ray evidence alone may show many unsuspected things about the appendix—often things which need not bother the patient very much. The most important of the signs are tenderness, constant changes in shape, fixation and abnormal position—the less important ones are filling and emptying and signs of fecal residue.

The Roentgen Diagnosis of Ulcus Duodeni with Respect to the Local Direct Roentgen Symptoms. Aeke Aekerlund, M.D., Stockholm. Acta Radiologica, 2:14-30, No. 5, 1923.

IN THE diagnosis of duodenal ulcer schematic procedure never leads to the goal and a capacity for individualization and for patience is requisite for good results.

In Stockholm there has been worked out a technique which shows the influence of many different techniques in use over the world. The method is not wasteful of time nor is it very expensive; 15 to 30 minutes suffices for examination and three plates, 18 by 20 cm. are sufficient to take all the pictures needed.

Intimate cooperation between fluoroscopy and roentgenography is a part of the method. By the former the efforts to fill the bulb are controlled, and the degree to which it is filled is determined, as is also the right moment for exposure and the directions for projection. A thin well mixed opaque meal is used. If the bulb does not fill of itself after a reasonable length of time it may be aided by manual expression of the stomach contents, by use of the right lateral position (especially in fat patients), or by blocking of the pars inferior duodeni. The arrangements for the exact adjusting of small plates and for taking small serial pictures of the duodenum in different positions of the body are described thus:

"Between the patient and the fluorescent screen I use a casette holder consisting of a pasteboard sheet or a wooden plate inserted in a thin steel frame. On this cassette holder the required picture surface is marked under floroscopic control by a couple of adjustable metal bands that can easily and conveniently be shifted as required from the margins of the cassette holder. When the cassette holder has been fixed in relation to the patient the fluoroscopy is broken off and the fluorescent screen is removed with a single manipulation and by means of a spring on the cassette holder a plate is fixed quickly and precisely in the place of the fluoroscopic picture. In this way an exposure can be made—as needed sometimes—a second or two after the breaking off of the fluoroscopy.

"For the taking of serial pictures I make use of a particularly simple arrangement. To expose four pictures on every plate only one lead sheet is required of 1.5 mm. thickness and of suitable size, furnished with a central square window the size of which shall represent exactly a fourth of the plate employed. The plate is shifted by hand in relation to the lead window between each exposure and is fixed in the different positions by a spring; a fourth of the plate is exposed each time, situated in one of the four corners of the plate. For most cases a plate of 18 by 24 cm. in size is quite sufficient for such serial pictures, as each picture will be 8 by 12 cm. At the adjustment for serial roentgenography in standing position the lead sheet is first fixed to the cassette holder with the window either standing (vertical) or recumbent (horizontal) after which the cassette holder is adjusted under fluoroscopic control

so that the bulb appears exactly in the middle of the lead window; the exposures are then made at desired speed. For my own part, I generally expose the different pictures in a series with about one-half minute's interval.

"Serial pictures ought to be able to be taken in every position required; for serial photographs in various recumbent positions only a wooden tunnel is required with a lead window on the surface turned towards the patient.

"Respecting the technique, it may be further added that the time for exposure must be so short that the pictures become sharp; in other words, it should not exceed 0.4 to 0.5 seconds.

The following paragraphs are copied from a summary of the article appended to the original paper:

"The changes in the form of the bulb constitute the central point in the direct roentgen diagnosis of the duodenal ulcer. The author distinguishes four kinds of ulcer deformities in the bulb: niche, defect(retraction and diverticulum.

"According to the author, the bulbar niche is by no means rare. Out of material of about 100 positive cases of duodenal ulcer, collected during the course of two years at a hospital, he observed the niche symptom in the bulb in rather more than 60 per cent.

"The bulbar niche is most often localized to the lesser curvature side, which is retracted. As a rule, a local, circular and often spastic constriction (defect) occurs in the niche plane from the greater curvature side. The bulbar deformity hereby arising which may be called a miniature picture of the ulcer deformity of the stomach, constitutes in the author's opinion the most typical ulcer deformity in the bulb and has been confirmed by him in more than 50 per cent of the above mentioned cases.

"The author ascribes a certain importance to the spastic, circular bulbar constriction in the ulcer plane, which usually appears more marked during the later stages of digestion, in respect to the cause of the paradoxical four hours retention by uncomplicated duodenal ulcers with initial hypermotility and very likely also in respect to the origin of the typical hunger pains.

"The spastic shortening (retraction) of the longitudinal muscles, which are particularly strongly developed in the medial bulbar region, and which may result in a pyloric insufficiency directly observable in the roentgen picture, offers a mechanical explanation of the initial hypermotility.

"Among the differential-diagnostically important affections the author especially mentions those of the gall-bladder and new growths of the bulb.

"The author's statistics from operative and postmortem material show correct roentgen diagnosis in rather more than 60 per cent; correct diagnosis of probability in a further 20 per cent. In the remaining cases it was not possible to make a roentgen diagnosis or it was only made alternatively. The roentgen diagnosis was obviously incorrect only in 5.6 per cent of the total number of cases."

The Role of Radium Needles in the Treatment of Neoplastic Diseases. William L. Clark, M.D., Am. J. Roentgenol., 10:204-208, March, 1923.

IN HIS introductory remarks the author says that the radium therapist, in addition to skill, must be broad enough of vision to recognize the importance of other forms of treatment and he specifically mentions operative and electrothermic treatment.

In using radium needles the dosage is very important, and it is also very difficult to estimate. The anatomical localization of the lesion, its type, and the grade of malignancy involved are factors governing the dosage and great harm may result to the patient if ignorance regarding these factors exists.

The needles must be used guardedly near bone. When 10 mg. needles are inserted into malignant tissue the distance should be not greater than 25 mm. It is inadvisable to employ needles a second time after a maximum dose has been given with them, since the tissue may break down. However, x-rays or radium may be safely used on the surface. In localized basal cell epitheliomata or in localized malignancy of any type the author does not use the needles if electrodesiccation or electrocoagulation or surgery can be used to destroy the disease at once. If these methods are not possible, then the needles are employed.

In the discussion following the reading of this paper, Drs. Kirkendall, Pancoast and Clark endorsed the practice of sterilizing the needles by boiling. Dr. Bowing advised against withdrawal of needles by thread, as it cannot be sufficiently sterilized. He advised a fine resistant wire for this purpose. Dr. Aikins said that he preferred flat applicators to needles.

Statistics and Technique in the Treatment of Malignant Disease of the Skin by Radiation. Howard Morrow, M.D., *and* Laurence Taussig, M.D., Am. J. Roentgenol., 10:212-213, March, 1923.

THE TECHNIQUE of treating basal cell epitheliomata, squamous cell epitheliomata and the various types of cutaneous sarcomata is discussed and statistics from 371 cases are presented.

The authors state that their experience convinces them that radium therapy combined with other methods is the most satisfactory way to treat cutaneous malignancy in appropriate cases.

A Report of Two Cases of Malignancy in Xeroderma Pigmentosum and Their Response to Radium. E. P. Pendergrass, M.D., *and* I. S. Ravdin, M.D., Urologic and Cutaneous Rev., 27:207, April, 1923.

RADIUM and electrothermic coagulation was used in the two cases of malignancy here reported. It is from the viewpoint of the malignancy that the results are tabulated, as radium has no effect upon the other condition.

The two cases are clinically well today. A distinct change was visible within a week in both these cases, and in the one case which had metastatic glands these disappeared.

Epithelioma of the Eyelids. Douglas W. Montgomery, M. D., *and* Geo. D. Culver, M.D. Urologic and Cutaneous Rev., 27:205-207, April, 1923.

GROWTHS involving the inner canthus of the eye, when treated with radium, clear up with remarkably little interference with the lacrymal duct. Seven such cases are reported, the outline of the reports is as follows:

1. May, 1918. Patient aged 59 years. Recurrent growth. Condition still excellent.

2. October, 1918. Patient aged 81 years. Fourteen years since first appearance of growth, which now involved the orbital cavity. Complete relief from pain, but, of course, not cured.

3. No date given. Patient aged 79. Growth spreading over glabella. Readily controlled.

4. May, 1920. Growth of eight years duration and rodent type involving the edge. Result: delicate scar tissue, lower lid cannot fully close. No sign of recurrence February, 1923.

5. January, 1921. Patient aged 62. Ten years duration, ulcerated for two months. No sign of recurrence February, 1923.

6. No date. Patient aged 70. Ten years since first appearance of growth. Healed without trace.

7. February, 1922. Patient aged 63 years. Growth extending deeply into canthus. Condition excellent November, 1922, when last reported.

Epithelioma of the edge of the lid is reported in seven cases. In one of these cases the growth was of the upper lid. All were treated with radium and all have remained healed throughout periods varying from five years to a year.

Another case had a large flat rodent epithelioma which involved the cutaneous surface of both lids and extended into the cheek. This growth invaded the palpebral conjunctiva at the external angle where there was an extropian. The author remarks that the conjunctiva is very resistant both to invasion and to deleterious effects of electro-magnetic energy and is not easily burned as is the mucous membrane of the mouth and rectum. This particular case was cleared up without any impairment of the function of the lids and has remained well since October, 1920.

Excellent cosmetic and functional results have been sceured by this author and he believes that radium treatment decidedly lessens the danger of recurrence in these growths.

The Treatment by Radiation of Cancer of the Rectum. Harry H. Bowing, M.D., *and* Frank W. Anderson, M.D., Am. J. Roentgenol., 10:230-239, March, 1923.

THE AUTHOR'S summary of this paper reads as follows: (1) Radium, if properly applied, causes a definite inhibitory and destructive effect in the majority of neoplasms of the rectum. (2) Sufficient evidence is available to prove that radium is a valuable adjunct when added to our present surgical measures in the treatment of cancer of the rectum. The closest cooperation between surgeon and radiologist is essential. (3) In order to give the best possible individual treatment and to avoid discredit of either surgery alone or surgery and radium and roentgen ray, an abdominal exploration should be made, except in gross inoperable cases. (4) Following exploration which determines inoperability with little or no low obstruction, it is not essential to make a colostomy in order to give the radium and roentgen ray treatment as outlined. Observation at intervals of from six to eight weeks is essential for the purpose of determining the advisability of radical operation. (5) The majority of patients with gross inoperable lesions should be given the benefit of the radium and roentgen ray therapy. A colostomy should be made at the first sign of impending obstruction. (6) The majority of patients receive inadequate treatment. It is impossible to give intensive treatment to some patients because of their general condition and because the entire tumor cannot be exposed. In patients with a colostomy, the growth should be treated through the distal loop. If the mass can be palpated by digital examination of the vagina this cavity should be packed with radium in close proximity to the rectal tumor. (7) Early diagnosis is paramount. A digital examination should be made routinely of all patients. An early protoscopic examination by an inexperienced physician is better than a late examination by a proficient proctologist. Microscopic examination is of definite value in early cases and will help to classify the cases, as well as to furnish a basis for prognosis when patients are operated on. (8) Some neoplasms of the rectum respond readily, while others are resistant to radium and roentgen rays. Long survival is possible in untreated cancer of the rectum. Our conclusions must be guarded until a large series of cases is available and sufficient time has elapsed. (9) Since radium in larger quantities and high voltage roentgen ray equipment are at present available, a combination of these is the most ideal method for radiation therapy, and results should be better."

The Treatment of Carcinoma of the Uterus, with Special Reference to Surgery, X-ray and Radium. Henry Schmitz, M.D., Northwest Med., 22:77, March, 1923.

THE SUCCESS of any method in dealing with this lesion depends upon a correct diagnosis, which must include a clinical and histologic diagnosis and also a determination of the extent of a neoplasm within the body.

The author thus summarizes his paper: "(1) Cervical carcinomata must be grouped for purposes of prognosis and treatment. (2) Careful statistics must be kept to establish the efficiency of the treatment. (3) Studying the grouping and the treatment we may establish the following rules for treatment: (a) Localized carcinomata, associated with grave constitutional diseases, should be treated by a panhysterectomy. (b) Border-line and clearly inoperable, and operable but complicated cases should be treated by a combined full dose of gamma and x-rays. (c) Advanced and recurrent cases should be treated palliatively by x-rays or radium. (4) Radiation therapy should not be preceded or succeeded by surgical therapy. The latter is not only unnecessary but decidedly diminishes the good results observed after radiation therapy. (5) Repetition of a course of radiation treatment is not advisable. It will not improve the results of the first treatment and almost invariably will be followed by severe and permanent issue injuries."

Exact Localization of Renal Calculi by Roentgenography of the Profile of the Kidney. Drs. Bazy *and* Lazarenne. Bull. et mem. Soc. de chir. de Paris, 49:400-409, No. 9.

THE ordinary roentgenography of the kidneys does not permit the visualization of the superior poles, especially of the right side.

Using the Carelli method of perirenal insufflation we get a very distinct image of the kidney with its superior pole, but a roentgenogram was thought obtainable only in the anteroposterior position. A profile projection has also been thought to be impossible because of the fact that the two kidneys with the spinal column are in the same line with those shadows, consequently superimposed upon one another.

The authors, however, found that a perirenal insufflation as in the Carelli method makes the kidney float in the free space caused by tension of the air in the capsule. The peritoneum is pushed forward and the kidney retained only by its vascular pedicle floats freely, and with slight forward rotation of the patient it is displaced forward and thus isolated from the other kidney and spinal column which remain posteriorly. A number of views must be made before a perfect profile image is obtained.

The advantages of this method are incontestable, according to the authors, in (1) permitting the study of the kidney on its several faces; (2) in differentiating renal calculi from those of the gall-bladder; (3) in localizing exactly the position of such calculi in the same manner as projectiles are localized by having two axes.

The authors used 300 c.c. of oxygen which they injected into the perirenal capsule by the Carelli method.

The accompanying prints are very clear and helpful.

A. M. PFEFFER, M. D.

X-ray Studies on Cardiac Diseases in Children. W. Morgan Hartshorn, M.D., *and* C. Winfield Perkins, M.D., New York M. J. & M. Rec., 117:268, March, 1923.

THIS ARTICLE, freely illustrated with radiographs, presents the following conclusions:

1. The x-ray examination in cardiac diseases of young children is of material aid in confirming physical signs.

2. It presents an accurate method of differentiating normal from abnormal hearts in children at different ages.

3. Progress of the disease may be noted by successive x-ray examinations.

4. At all ages in the normal, there is a constant ratio between the transverse diameter of the heart and the transverse diameter of the chest.

5. As a method of differentiating between congenital heart disease and thymus disease it is invaluable.

6. Associated pathological conditions of the chest can be demonstrated.

7. Advanced cardiac disease is associated with marked increased peribronchial shadows, fanlike in character

confined to the upper lobes of the lungs.

8. Distortions in the shadow of the heart due to imperfect technique may simulate pathological conditions.

9. Successive x-ray examinations should be taken in the same positions at same distance and with the same exposure.

W. W. WATKINS, M.D.

Results of Treatment in One Hundred Consecutive Cases of Hyperthyroidism. Hugo A. Freund, M.D., New York M. J. & M. Rec., 117:395, April 4, 1923.

THIS REPORT covers patients treated over a period of two and a half years, the last treatment being more than six months previous. The series included functional, adenomatous and hyperplastic types of goiter.

The treatment varied according to the indications, seeking to bring about a reduction of the metabolic rate to normal. Regarding radiation, the author says:

"Ever since the destructive effect of the roentgen ray has been recognized, it has been used in one form or another in the treatment of thyroid diseases. Its valuable effects have been recorded at various times. However, only within recent years has a systematic study of such cases been pursued. The controlled use with definite dose of the x-ray has made such studies statistically reliable. Checked up by frequent basal metabolism studies, its effects can be so carefully observed that it forms a method of treatment both safe and simple. My conclusions from its use in one hundred consecutive cases, which have been under observation for from six months to three years, are that in the majority of cases it promptly and effectively destroys portions of the gland producing thyroid hyperactivity; that failure to give complete relief does not interfere with subsequent surgical removal of large, hypertrophied adenomatous portions of gland and that its control places its value as a remedial agent far above the surgical method of removal of uncertain amounts of the diseased gland."

W. W. WATKINS, M.D.

Pathogenesis and Treatment of Exophthalmic Goiter in the Light of Our Present Knowledge. Alfred Gordon, M.D., New York M. J. & M. Rec., 117:385, April, 1923.

THIS AUTHOR discusses the pathogenesis of exophthalmic goiter and the treatment with regard to medical treatment, surgical treatment and radiotherapy. With regard to the surgical treatment he concludes that "the results of surgical intervention are various, partial or complete successes may be met with as well as failures by all methods."

With regard to radiotherapy, he says weekly applications of x-rays to the lateral and median lobes are sometimes useful. Beclere advises continuous applications until the morning pulse is 80 and until there is increase in weight. The functional disturbances usually improve rapidly, but the thyroid and exophthalmos are the last to improve.

In the grave forms a trial of medications, together with dietetic and hygienic rules, hydrotherapy, electrotherapy and radiotherapy should always be considered and administered, and only in case of absolute failure is surgical intervention in several seances to be considered.

W. W. WATKINS, M.D.

Thyroid Diseases Benefited by X-ray Treatment. R. G. Allison, M. D., Journal-Lancet, 43:169, April, 1923.

THIS BRIEF article is a part of a symposium on thyroid diseases given before the Henepin County Medical Society and consisting of ten papers.

Twenty-seven cases of Graves' Disease without complications, whose treatment had been completed more than eight months, were reported. Twenty-four of these were well, clinically and from a laboratory standpoint. Three had come to operation, one of these showing marked improvement before operation. Six cases of postoperative hyperthyroidism were treated, only one showing improvement. Three cases of toxic adenoma were treated, none showing improvement.

The technique used was 30 ma., 10 inch distance, 4 mm. Al, 8 inch spark gap, and three portals, at three week intervals. If no improvement occurred by the fourth treatment, time was increased to 34 ma.

W. W. WATKINS, M.D.

Some Observations Upon the Histological Changes in Lymphatic Glands Following Exposure to Radium. I. C. Mottram, M. D., Research Dept., Radium Inst., London, Am. J. M. Sc., 165:469, April, 1923.

THE CONCLUSIONS drawn from the reported observations are made with diffidence, but with the idea of encouraging other workers to take up what appears to be a profitable line of investigation.

The reported findngs would appear to be in opposition to the conclusions of Murphy, of the Rockefeller Institute, that small doses of roentgen rays or radium stimulated lymphocytic formation, the author's conclusions being that the apparent accumulation of lymphocytes following such doses is really due to a massing of dead and degenerated cells in the glands.

The histologic structure of the glands is discussed and the changes occurring after exposure to radium, the lymphopenia in the general circulation being coincident with the accumulation of degenerated lymphocytes in the glands. The endothelial cells of the gland follicles are assigned a phagocytic activity in the ingestion of the degenerated lymphocytes, and not their supposed function of producing lymphocytes by mitosis.

W. W. WATKINS, M.D.

Analysis of X-ray and Operative Findings in Eighty-six Abdominal Cases. C. Harvey Jewett, M.D., Clifton Springs, N. Y., Clifton Medical Bulletin, December, 1922.

THIS is a report of eighty-six cases of gastro-intestinal disease, diagnosed by x-ray examination and afterwards operated. The report is made to illustrate the percentage of correct diagnoses and to show the frequency of lesions not detected by the x-ray examination.

Six cases of gastric ulcer were diagnosed and all confirmed by operation.

Seven cases of gastric carcinoma were diagnosed; six were confirmed by operation, the other case being ulcer with adhesions to the transverse colon.

Ten cases were diagnosed duodenal ulcer, confirmation by operation in seven, the others being adhesions.

Eleven cases were diagnosed gallbladder disease; stones were diagnosed in five, all confirmed by operation; stones were found in one other case, not shown by x-ray. Gall-bladder adhesions were diagnosed in the remaining six, verified in three cases.

Sixteen cases of appendiceal disease were diagnosed, with operative confirmation in all; half of these cases, however, showed associated lesions not diagnosed in the x-ray examination.

Twenty-two cases of intestinal adhesions were diagnosed and verified at operation, many of these showing more extensive involvement than the x-ray examination indicated.

The x-ray diagnosis was verified at operation n 84 per cent of the cases. In 19 per cent additional lesions were found, not shown by x-ray.

W. W. WATKINS, M.D.

The Roentgenological Symptom Complex of Horseshoe Kidney. N. Voorhoeve, M.D., Fortschr. a.d. Geb. d. Roentgenstrahlen, 30:201-210, Feb., 1923.

CLINICAL diagnosis of the presence of horseshoe kidney is usually very difficult. Rarely can one note on pal-

pation the presence of a bridge transversely across the spinal column connecting both lower poles of the kidneys as has been described by Israel and by Zondek. This is impossible to make out when the patient is too fat, or when the connecting bridge is too narrow, or when the bridge unites the upper poles. Also the anamnestic data are few and vague. Patients seek advice only when complications set in such as stone and pyonephrosis which occur in a greater percentage in horseshoe kidneys. Most of the roentgen examinations are made by the methods usual for the purpose of revealing ordinary pathology. The author had two patients sent to him for roentgen diagnosis of calculus, and whom he accidentally discovered to have horseshoe kidneys.

The author does not agree with the generally prevalent idea that only pyelography with palpation can demonstrate a horseshoe kidney, nor does he depend, as have some other investigators, upon the position of a stone in the median line or in the bend of the kidney. In his two cases he made a diagnosis by simple unaided roentgen examination.

In the first case, that of a man aged 40, the author found one stone in the right kidney and three stones in the left. The kidney outlines were strictly parallel with the spinal column, both were strongly median, almost on the spinal column, both were ptosed markedly and the degree of ptosis was markedly alike in both sides. This picture suggested the probability of horseshoe kidney.

Further examination showed that it was impossible to move the kidneys away from the median line; that they moved easily up and down, showing a change of position when taken in extreme expiration and in extreme inspiration. The connecting bridge could not be demonstrated, but due to this bridge running ventrally across the spine the lower poles of the kidney were naturally more ventrally placed than the ventral plane of the vertebral bodies, while in the normal they are found posteriorly to that level. The author found that the lower poles moved in the opposite direction in relation to the tube in ventro-dorsal direction of the rays, and in the same direcion with the tube in the dorso-ventral direction of the rays, when compared with the spinal column. The case is just the opposite in the normal.

In a second case, a stout individual, 48 years of age, all previously mentioned symptoms were present in addition to a demonstrable connecting bridge which appeared as a cow horn on either side of the spinal column. After operation, which consisted of the removal of the bridge with a portion of the left kidney, the specimen was roentgenographed and was found to represent the shadows in the original roentgenogram.

The tube position in the median line throws the outline of the inner border of the kidney somewhat more laterally and the complete rounded lower pole fails to appear. Often the portion of the bridge is demonstrated. The following paragraph summarizes the author's findings:

"Both kidneys are in vertical position, and their inner borders are parallel with the spine. They are in the median position, the distance between the inner border and the spine is abnormally small. There is double ptosis, often in the same degree in both sides; immobility of the kidneys in the mediolateral direction; apparent superimposition of the lower poles on the spine and movement in an opposite direction in ventrodorsal direction of the rays, and in the same direction in the dorsoventral course of the rays; eventual visualization of the connecting bridge.

A. M. PFEFFER, M. D.

Some Observations on Radium Therapy in Cancer at the Institute of Radium, Paris. Malford W. Thewlis, M.D., Rhode Island M. J., 6:39, March, 1923.

REGAUD'S technique is different from that which we are accustomed to observe; he and his collaborators were perhaps the first to use radiation of a feeble intensity prolonged over four, eight or ten days without interruption. He prefers the salts of radium to the emanation, as the radiation is much more constant with the former.

In cancer of the tongue, several sterilized needles are inserted into the tumor and into the healthy tissue at a distance of one and one-half cm. away from the tumor. These are left in place for eight days.

In cancer of the uterus a similar technique is employed, using emanation tubes in suitable containers, leaving the apparatus in place four to eight days, depending on the type of cancer present. They are removed daily for the purpose of giving a cleansing douche.

This treatment is based on the idea that the cells must be subjected to radiation during division stages, when they are most vulnerable.

W. W. WATKINS, M.D.

The Scope of X-ray Therapy in Naval Practice. E. L. Whitehead, Lieut., M.C., U.S.N., U. S. Naval Bull., March, 1923, p. 309.

THIS is a detailed review of the advances in radiotherapy within the past few years, including apparatus, technique, biological effects and clinical application.

McKee and Andrews are quoted as giving a list of eighty skin diseases amenable to x-ray treatment, and many of these are reviewed, especially those most frequently found in naval hospital work.

Among the many and varied benign conditions in which radiotherapy is indicated as the treatment of choice are Hodgkin's disease, leukemia, mycosis fungoides, uterine fibroids, tuberculosis adenitis, selected cases of hyperthyroidism and hyperplastic tonsils.

The author states the situation with regard to the treatment of malignancy very aptly by saying, "In the treatment of malignant conditions lies, at once, roentgenotherapy's greatest triumph, greatest failure and greatest future." This field of work is yet in its infancy and the results so far secured justify hope of much greater success in the future.

W. W. WATKINS, M.D.

The Value of the Roentgen Ray in the Diagnosis and Prognosis of Sarcoma of the Long Bones. Henry W. Meyerding, M.D., J. Bone & Joint Surg., 5:323, April, 1923.

SUMMARY: The roentgen ray is one of the most valuable aids in the diagnosis and prognosis of sarcoma of the long bones. It reveals the location, size and extent, and to a certain degree, the structure and origin of the tumor and the presence of metastasis. It is the earliest aid in determining the presence of pulmonary metastasis, although the absence of demonstrable lesions does not mean that metastasis has not occurred. Roentgenograms of the lungs should be made as a routine measure in every case of suspected malignant tumor of the long bones, particularly if surgical removal of the primary tumor is contemplated.

Every injury to the bone or suspected lesion should be examined roentgenologically. Treatment with radium, the roentgen ray and Coley's toxin appears to be beneficial in the control of certain malignant lesions of the bone, but thus far none of these aids has proved adequate.

Nine cases are reported.

W. W. WATKINS, M.D.

Congenital Torticollis with Malformation of the Seventh Cervical Vertebra and Painful Shoulder. Dr. Nove-Josserand, Lyon chir., 19:797-799, Dec., 1922.

A CASE of congenital torticollis is presented. An induration of the right, sternocleidomastoid muscle was noted at birth, the delivery being

effected by application of forceps. At 6 years of age, there was torticollis of a medium degree, some slight facial asymmetry, cervical scoliosis with the convexity to the left, and slight occipital compensation.

A resection of the sternomastoid muscle brought about a complete correction with no after effects for many years.

For the past two years the patient has experienced pain in the right shoulder, especially in certain movements as in putting on clothes or playing tennis.

Examination shows the painful spot localized on the anterior surface of the shoulder medial to the coracoid process. There is also slight atrophy of the arm as compared to the one of the left side, but no disturbance of sensibility. The pain does not radiate to the arm.

The roentgenogram of the shoulder gave normal findings. The one of the cervical spine revealed an abnormally long transverse process of the seventh cervical on the right side, twice the length of the transverse process of the first dorsal, with complete absence of a process on the left side.

The author is of the opinion that the muscular retraction on the right side was not caused by any obstetrical traumatism, but by an ischemia resulting from the spinal anomaly; that although the case appeared to be typical of a muscular torticollis, yet the spinal malformation is to be regarded as the actual cause.

The author treated another case of muscular torticollis associated with scoliosis. A roentgenogram revealed a fissured posterior arch of the axis forming two unequal branches.

A. M. Pfeffer, M. D.

Sacroiliac Arthrosis Obliterans. E. S. Blaine, M.D., Am. J. Roentgenol., 10:189-194, March, 1923.

CAREFUL x-ray study and clinical examination of all patients suffering from backache should be made.

Out of 1,800 lower spine cases the author found 18 with unusual changes in the sacroiliac joints; all these cases were under 30 years of age and some were younger than 25 years. Complaints were of dull pain, soreness, stiffness and discomfort. There was more or less spinal rigidity, considerable limitation of motion and slight tenderness over the sacroiliac parts and the lower lumbar parts of the spine, and in some the normal lumbar curve was obliterated. The condition is very slowly progressive. The x-ray will show gross intrinsic joint changes, the majority of these being bilateral. Intimate changes cannot be demonstrated. A combination of destructive and constructive changes is the essential alteration, seeming to indicate a low grade type of joint infection of marked chronicity. "An early disease of the joint may be deduced by a comparative decrease in the sharpness of the joint edges, these appearing to be somewhat hazy in shadow detail." A further advance in disease is indicated by erosin of the articular surface edges, and a still further degree is indicated by a material decrease in the interarticular distance between the sacrum and the ilium. These two bones may come in contact and may even fuse.

In the differentiation from typhoid arthritis the history is the only aid mentioned. In chronic hypertrophic osteoarthritis the articular surfaces will present less change and there will not be the erosion of the articular surfaces. Also many joints may be involved which is not the case in the lesion named in the title of this paper. In tuberculous arthritis of the sacroiliac joints the lesion is seldom bilateral and produces rather extensive softening of the cancellous bone tissue in the surrounding bones with far greater destruction of tissue.

The author contemplates further study and presentation of this subject.

The Association of the Surgeon and the Radiologist in Bone Grafting. St. I. D. Buxton, M.B., B.S., Arch. Radiol. & Electroth., 27: 289-304, March, 1923.

THE FATE and the effect on the bone of metal plates, bolts and bone grafts introduced into the tissues in the treatment of fractures may be ascertained by the x-ray and is a wonderful aid in surgery. A loose plate, the formation of a false joint or the fracture of a bone graft is often thus diagnosed. It is said that the function of periosteum, bone, and the method of union following bone grafting can be studied by radiography as well as by the microscope.

Surgical procedure is discussed in detail and the exposition of radiographic diagnosis is aided by 24 illustrations.

Outline of Ultra-Violet Therapy. By A. I. Pacini, M.D., 12mo., 204 pp., 22 illus. Cloth, $3.50. Chicago, Poole Bros., 1923.

THIS BOOK discusses the general principles involved in ultraviolet therapy. The author remarks that the vastness of this subject and the unorganized state of the knowledge pertaining thereto has made it difficult to attain logical sequence in its presentation. However, he has succeeded in assembling the pertinent facts and elucidating the principles of ultraviolet therapy in an enlightening and useful publication, published in a very convenient size and printed in very readable type. Besides the 22 illustrations, mostly of apparatus, there are numerous therapeutic tables of value in practice.

Chapter I deals with the general principles involved in the subject of ultraviolet radiation. Chapter II treats of the properties of the air cooled lamp, Chapter III of those of the water cooled lamp. Chapter IV discusses regional actinotherapy, most of the space being devoted to the subject of gastric disorders. It also contains an interesting page upon subjective and objective pain. Chapter V deals with pelvic visceral disorders. In this chapter the author warns against over enthusiasm in the use of ultraviolet therapy in these lesions, but strongly advocates its sane and wise application.

Chapter VI defines and gives directions for using fractional actinotherapy. This method combined with the usual therapeutic measures has been found very useful in the various tuberculopathies. The following chapter takes up the subject of systemic actinotherapy. The systemic uplift resulting from general ultraviolet treatment is largely due to the increased hemoglobin content and increased calcium metabolism and is of great value in cancer treatment by whatever method. General treatment is of very great value in certain diseases of the bones, and in some of these it is almost a specific. Rickets, achondroplasia, osteogenesis imperfecta and osteomalachia are discussed in relation to ultraviolet therapy.

Chapter VIII has for its subject intensive actinotherapy, and the principles of stimulative, regenerative and destructive erythema dosage are here discussed together with the disease conditions in which they have been found to be of value.

Chapter IX, "Bactericidal Actinotherapy," is an interesting chapter. The last two chapters are upon "Abiotic Actinotherapy" and "Actinotherapy in Metabolism," and are equally interesting.

The lack of an index and a number of typigraphical errors are the criticisms that the reviewer would offer upon this excellent publication.

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Radiography in the Examination of the Urinary Tract*

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MUCH interest has been expressed regarding the findings and technique in the roentgenologic examination of the urinary tract. In view of this, I selected for study the consecutive histories of 1,000 patients from 6,908 in whom the urinary tract had been examined roentgenologically in the Mayo Clinic in 1921. These 1,000 patients represent approximately ten per cent of the patients who registered in the Clinic during this time. Registration numbers are issued to the patients in numerical sequence; thus it is possible to carry out an accurate statistical study of the findings in any series of cases. Five hundred and eight of the patients were males and four hundred and ninety-two females. Their ages varied from:

Years	Patients	Years	Patients
1 to 10	7	51 to 60	189
11 to 20	28	61 to 70	118
21 to 30	140	71 to 80	22
31 to 40	258	81 to 90	2
41 to 50	236		

The youngest patient was 3 years of age; the oldest 83.

Of the 1,000 cases studied, the roentgenologic findings were negative in 624 (62.4 per cent). The positive findings are presented in tabular form (Tables 1 and 2).

Since my purpose in making this study was to trace the ultimate findings in a series of one thousand routine investigations of the urinary tract I have combined the cystoscopic and surgical findings for the obvious reason that in many instances the cystoscopic and the surgical findings were identical, patients often being referred for surgical treatment as a result of the cystoscopic findings.

One or more of these conditions may exist in the same patient; for example, pyonephrosis with multiple stones, or associated deformities and lesions of the ureters such as hydro-ureter and strictures with dilatation; these, however, were not charted as definite entities.

Cystoscopic examination was made in 327 (32.7 per cent) of the one thousand cases, and the findings proved to be negative in 62 (18.96 per cent).

TABLE I.

Kidney	Ureter	Bladder
Stones diagnosed from roentgenograms and found by cystoscopic or surgical examination in the urinary tract.		
Males 29	Males 9	Males 6
Years	Years	Years
Youngest 33	Youngest 31	Youngest 31
Oldest 60	Oldest 61	Oldest 77
Average 45	Average 45	Average 52
Females 8	Females 5	
Youngest 18	Youngest 22	
Oldest 67	Oldest 53	
Average 43	Average 36	
Stones not diagnosed from roentgenograms, but found by cystoscopic or surgical examination—**		
Males 3	Males 6	Males 4
Youngest 30	Youngest 23	Youngest 56
Oldest 50	Oldest 43	Oldest 66
Average 39	Average 34	Average 63
Females 1	Females 4	
Average 41	Youngest 40	
	Oldest 53	
	Average 47	
Stones diagnosed from roentgenograms and ruled out by cystoscopic examination		
Males 2	Males 6	Males 3
Youngest 41	Youngest 29	Youngest 36
Oldest 55	Oldest 65	Oldest 63
Average 48	Average 50	Average 52
Females 2	Females 8	
Youngest 36	Youngest 35	
Oldest 62	Oldest 71	
Average 49	Average 48	
Stones diagnosed from roentgenograms and not found by cystoscopic examination		
Males 12	Males 6	One prostrate shadow reported was calcified prostate.
Youngest 19	Youngest 23	
Oldest 65	Oldest 43	
Average 43	Average 34	
Females 15	Females 4	
Youngest 19	Youngest 40	
Oldest 61	Oldest 53	
Average 45	Average 46	
Total 41	Total 24	Total 10
Right side 15	Right side 13	
Left side 23	Left side 10	
Bilateral 3	Bilateral 1	

*—6 were reported as phleboliths

Ultimate Diagnosis in Cases Negative for Lesions of the Urinary Tract

In 114 of the 624 patients in whom the findings were negative roentgenologically, the ultimate diagnosis was cholecystitis. Of these, a clinical diagnosis was made of cholecystitis in 50, of cholecystitis with stones in 11, cholecystitis was found at operation in 15, and cholecystitis with stones, at operation in 38.

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 7, 1922.

Forty-three of the 624 patients had appendicitis; in 22 the condition was diagnosed clinically; in 21 it was found at operation.

Three hundred and seventy-six patients (37.6 per cent) had phleboliths; 197 of these were males (average age, 48 years) and 179 females (average age, 44). Phleboliths are small, calcified thrombi on the distal sides of the valves in the vesico-prostatic and the vesico-uterine plexuses around the base and neck of the bladder and the prostate gland in the male, and around the base and neck of the bladder and the vagina in the female. In advanced life the veins of these plexuses become enormously distended and varicosed and often contain small concretions. They are usually multiple and are seen commonly in the region of the ischial tuberosities and lower pelvis. They are sharply outlined, circular or oval in shape, and although they do not ordinarily offer any difficulty, their location may make it hard to distinguish them from small ureteral calculi. In 22 cases of ureteral stone found at cystoscopic examination or at operation six had been diagnosed from the roentgenograms as phleboliths.

Hypertrophic arthritis was an incidental finding in 82 patients, 61 males (average age 56) and 21 females (average age 51). This lesion increases in frequency of incidence as age advances and may cause pain simulating

TABLE II.

CYSTOSCOPIC AND SURGICAL FINDINGS

Kidneys	*Cases*	*Bladder*	*Cases*
Essential hematuria	13	Cystitis	33
Posttraumatic hematuria	1	Trigonitis	7
Stone-forming kidney	5	Contracted bladder	1
Pyelonephritis	11	Diverticulum of bladder	6
Pyonephrosis	14	Tumors of the bladder	13
Genito-urinary tuberculosis	7	Vesico-vaginal fistula	1
Hydronephrosis	12	Enuresis, no lesion	1
Ptosis	4	Cord bladder	2
Tumors of the kidney	4	Trabeculated bladder	2
Postoperative deformity	1	Deformity from extra-vesical pressure	3
Extrarenal tumor	2		
Anomalies of kidney and ureter	4		
Prostate	*Cases*	*Urethra*	*Cases*
Prostatitis	15	Urethritis	15
Hyper-prostate	26	Urethral stricture	9
		Relaxed urethral sphincter	2

that of stone or other lesion in the urinary tract.

Bifurcation and sacralization of the transverse processes of the fifth lumbar vertebra was another incidental finding in 20 cases, which like hypertrophic arthritis, might cause pain and, associated with urinary findings, would suggest investigation of the urinary tract. Spina bifida occulta was reported in 28 instances. While these congenital defects of development in the fifth lumbar or the upper sacral segments commonly have no clinical significance, they are infrequently associated with obscure disturbances of sphincter control, motor paralyses and sensory disturbances, and the knowledge of their existence is of value to the neurologist, particularly if patients have retention of urine, incontinence and enuresis.

INDICATIONS FOR THE ROENTGENOLOGIC INVESTIGATION OF THE URINARY TRACT

Braasch, in 1921, in his presidential address before the American Urological Association, concisely summed up the clinical data, other than that frankly suggestive of involvement of the urinary tract, that would indicate investigation roentgenographically. In brief, these indications, as noted by him, are: (1) a history of previous hematuria or pyuria, even though urinalysis is negative for the time being; (2) pus or blood cells in the urine, even though no other symptoms or physical data are suggestive of involvement of the urinary tract; (3) any tumor in the upper lateral abdominal quadrant or suprapubic area, or (4) a history of abdominal pain without definite evidence of disease in the intra-abdominal organs. He mentioned conditions which are commonly a source of confusion in diagnosis such as: (1) lesions with radiation of pain to the renal or suprapubic areas; (2) coincident lesions occurring in abdominal organs other than the bladder or kidneys, with the presence of pathologic elements in the urine; (3) abdominal lesions with a history of previous urinary symptoms; (4) doubtful sources of continued increase in temperature, particularly with a previous history of indefinite urinary symptoms, or with a few pus cells in the urine; (5) hepatic and appendiceal lesions with radiation of pain into the renal area, and (6) definite intra-abdominal lesions with evidence of coincident disease in the urinary tract.

These conditions and the lesions of the spine which I have mentioned as often being associated with suggestive urinary findings, constitute a considerable number of cases in which investigation of the urinary tract often is suggested, and account in part for the large percentage (62.4) of negative findings in this series. Moreover, all patients in the Clinic who are referred for cystoscopic examination have had a routine preliminary roentgenographic investigation of the urinary tract.

TECHNIQUE

The patients are given a referring card (Fig. 1) on which is the name and registration number of the patient with a brief note concerning the condition that suggested the examination, and are instructed regarding the preliminary preparation. This card is placed in an envelope on which are printed the instructions (so that they may be referred to) and also the number of the desk to which the patient will report with the day and hour and the name of the patient and the referring physician. The

FIGURE 1

Sheet 3. X-RAY REFERRING CARD

Name—A. B. Charlton. *No.* A345678

Date—11-24-22. *Referred by Dr.* White. *Sect.* Black

Part to be rayed—Kidney, ureters and bladder.

(Use separate cards for K. U. B., Chest, Bone, Stomach and Colon)

On account of—Pain, right renal, radiating down the thigh. (Be brief and confine remarks to this space.)

Report—Multiple small shadows in the right kidney area. Phleboliths on the left. M.

REFERRED FOR X-RAY OF KIDNEYS

Please present this envelope at desk A, 2nd floor, Clinic Building, at 8:00 A.M. Tuesday.

Instructions to Patient—

At 5:00 P. M. take two ounces of Castor Oil.

Do not eat supper or breakfast other than a cup of tea or coffee.

At 7 A. M., with a fountain syringe, take rectal injection of warm soap suds until water returns clean.

(Oil and syringe can be obtained at Weber & Judd Co.'s Drug Store on ground floor, Clinic Building.)

Name—A. B. Charlton.

Physician—White. C. H. W. P.

Fig. 1. Roentgenography in the examination of the urinary tract

instructions are to take 60 c.c. of castor oil at 5 o'clock, to abstain from supper and breakfast, other than fluids, and to take rectal injections in the morning until the discharge returns clear. Four roentgenograms, 20 by 25 cm., (Fig. 2) are made of each patient, without intensifying screens, one of each kidney area, one of the ureteral area and one of the pelvic and bladder area, the roentgenograms overlapping slightly. The roentgenograms are taken with the patient on the table in the recumbent position, with the arms at the sides, and the knees resting over an A shaped board that is hinged to allow adjustment to the height of the individual patient This position allows maximal relaxation of the abdominal muscles. A cone is used which gives an average distance of 62.5 cm. from target to plate, and on the end of this cone is an aluminum compression cap with a diameter of 12.5 cm. In making the roentgenograms of the kidney the cone is brought down immediately below the costal margin, in about the nipple line, as far as the patient can comfortably bear, and the carriage locked. After locking, the cone is tilted up under the costal margin to a varying degree according to the thickness of the patient. For the third roentgenogram the cone is brought straight down in the middle line, about half way between the umbilicus and the symphysis pubis; for the fourth the cone is brought down just above the symphysis pubis, and, after locking the carriage, the cone is tilted with the cap pointing toward the coccyx. We use plates because they are more convenient for our present organization; when films can be used with intensifying screens, equally good results are obtained with less exposure, but our experience has been that artefacts are more common in films, and the screens must be kept flawless at all times to avoid confusing shadows. We prefer single roentgenograms of each area made with the compression cap rather than attempt to cover both areas of a kidney on one roentgenogram by any method. A standard type Coolidge tube, of medium focus. is used with a setting varying from 50 to 60 kv., according to the thickness of the patient, 30 to 40 ma. and four to eight seconds. To avoid contact of the patient's knees with the high tension wire a bakelite shield is placed below the glass bowl of the tube stand (Fig. 3).

When the roentgenologic findings suggest it, the patient is referred to the Section on Urology. As each patient reports to this section, whether the findings have been positive or negative, all the roentgenograms made of that patient are placed on the view box of the section so that the findings may be checked by the urologic consultants. The Section on Urology has its own roentgen-ray apparatus with an overhead installation so that it is possible to make roentgenograms in the examining rooms. At present a portable tube stand is taken from room to room as required, but arrangements are under way to install a tube stand on each table (Fig. 4), as one already in operation, carrying a 30 ma. radiator tube with fine focus, has given excellent results. Twenty-five by thirty cm. duplitized films with double intensifying screens are now used for pyelograms. The equipment and technique are similar to that already described, the time being shortened, of course, by the screens. Three pyelograms are made, the first with the table tilted in the Trendelenburg position; the second, with the table in the horizontal, and the third with the table in the reverse Trendelenburg position. The complete urinary tract is included in the three pyelograms. Pyelograms are only made on one side, sufficient time being allowed for evidence of reaction before they are made on the other side. Sodium bromide solution (15 per cent) is injected by the syringe pressure method very slowly and until the patient experiences a feeling of fulness or pain in the region of the kidney. If pain is experienced with a very small quantity, the withdrawal of the catheter for a short distance will sometimes allow continuation of the injected material without distress. Before making the lower pyelogram of the series the pelvis of the kidney is drained, the catheter is withdrawn from the kidney, and the lower ureter reinjected as the third exposure is being made. Opaque catheters are used if the passage of the catheter has been obstructed, and if the solution has failed to pass a given point in a previous examination. They are also used in the examination for certain types of shadows in the region of the ureter, two exposures with the tube at widely separated angles or stereoscopic films being made to define the relation of the shadow to the ureter. In certain types of anomaly, such as reduplication of the renal pelves or ureters and

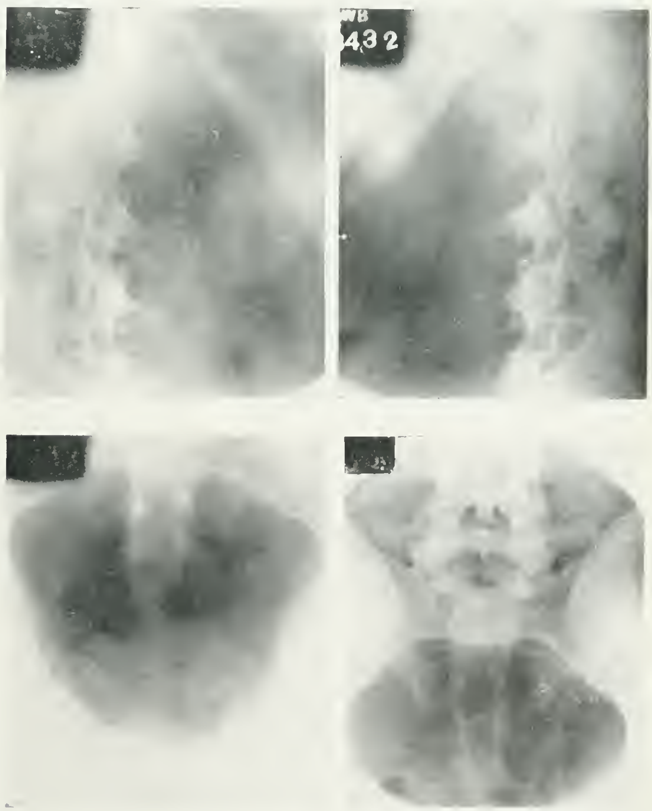

Fig. 2—Four areas included in the routine examination of the kidney, ureter and bladder.

horseshoe kidney, the opaque catheter is useful; it is sometimes coiled in the sac of a diverticulum in the bladder to gain information as to the size.

Cystograms are made by injecting the bladder with emulsion of silver iodid (5 per cent) and making two oblique views, one from the right and one from the left, with the tube angled twenty degrees laterally and toward the bladder, the compression cone resting just above the symphysis pubis. These oblique views will often show diverticula or cellules that would be missed by any other method. The bladder is then emptied and a straight view is taken over the bladder area; in many patients the injection will remain in the diverticula and valuable information will be afforded as to the size, the number and location of these, that cannot always be gained by the lateral views.

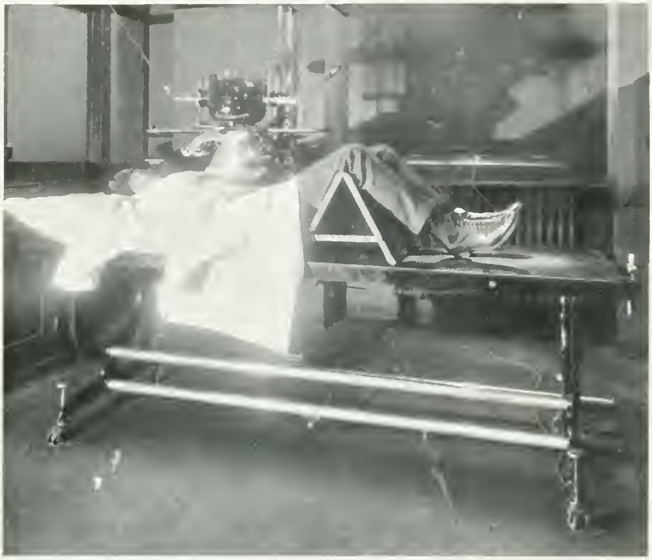

Fig. 3—The patient in position on the table with the A shaped board under the knees The bakelite shield prevents contact of the knees with the high tension wires.

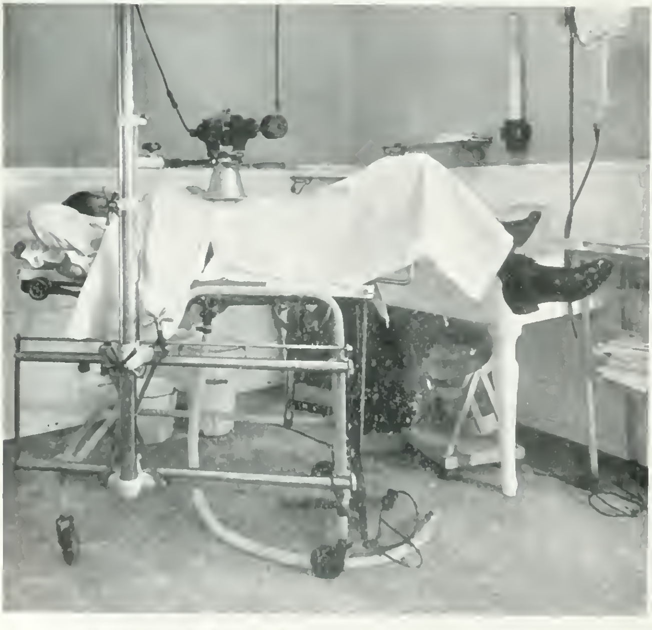

Fig. 4—The tube stand attached to the urologic examining table.

Urethrograms are made by placing the patient on the table with the left leg lying horizontally, the right leg elevated over the vertical stirrup, the pelvis tilted to an angle of approximately twenty degrees and the right thigh rotated slightly outward. The compression cone is brought down over the symphysis pubis. The urethra is injected by the gravity method, the container at a height of five to six feet, with a solution of sodium bromid (15 per cent) or by the syringe pressure method, using an emulsion of silver iodid (5 per cent), the exposure being made synchronously with the injection in both methods.

Prostatic calculi may occasionally be obscured by the bones of the pubic arch; these can be brought out by placing the patient in the prone position on the film and making an exposure with the compression cone over the anus, the ray being directed forward by angling the tube about twenty degrees.

For the last three years roentgenoscopy has been used with considerable success to assist the surgeons in locating and removing stones from the kidney. Prior to the observation the roentgenologist wears goggles of smoked glass or remains in a dark room for sufficient time to acquire dark-accomodation and retinal perception. A portable unit of the type that may be operated from an ordinary lamp socket is brought as near the operating table as possible, and after the kidney has been delivered from the wound the rays are focused through a small diaphragm so that they will fall through the kidney on the fluoroscopic screen. A hooded screen is held in the left hand of the roentgenologist, who makes the observation and with a metal rod, held in the right hand, accurately locates and guides the surgeon to the shadow. The exposure required is short; in the majority of cases it is little more than a flash.

Summary

In the one thousand cases studied, a total of 75 calculi were found by cystoscopic and surgical examination; 41 in the kidney, 24 in the ureter, and 10 in the bladder. The Section on Roentgenology reported 37 of the 41 in the kidney, 14 of the 24 in the ureter, and 6 of the 10 in the bladder. Thirty-one shadows diagnosed from the roentgenograms in the kidney area, 24 in the ureteral area, and 3 in the bladder area, as calculi or suggestive of

calculi, were ruled out or were not found at cystoscopic examination. Six of 10 calculi found in the ureters had been reported by the Section on Roentgenology as phleboliths. Phleboliths were reported in 376 patients. Shadows were often seen in the roentgenograms of areas embracing the urinary tract which were not seen in subsequent re-rays of the same areas. Eliminating the rare passing of a stone, the conclusion must be that these shadows were cast by small concretions or particles of insoluble material in the bowel. Small areas of calcification in the abdominal glands cast shadows very suggestive of calculus. We have seen several cases in which small warts on the skin have cast shadows which were difficult to distinguish from calculi. Roentgenologic evidence, therefore, cannot be accepted as final, but must be checked by urologic investigation and correlated with the clinical evidence.

Measurements on Two American Deep Therapy Machines, With Special Reference to the Duane Method*

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THIS brief paper must be regarded as a preliminary report. My object in presenting it is to call attention, (1) to the great importance of making measurements and making them frequently; (2) to a very valuable method, if not the most valuable method of making measurements; (3) to present some concrete data that will be helpful to some who may not yet have had the opportunity of measuring the output of their deep therapy machines.

As I have expressed myself before, I am fearful of the outcome of the use of these powerful high voltage machines when placed in the hands of untrained and inexperienced men. I have heard the same opinion expressed in Germany during the past summer, and yet some of these machines have been in use there for six or seven years. At first, however, these machines in Germany were used only in the universities, where they were under the control of experienced clinical radiologists and trained physicists. The contributions that come from great institutions such as those at Erlangen, Frankfurt, etc., in Germany, and Stockholm in Sweden have been most helpful to all the world. They have demonstrated superior results, and enthusiasm has become very great in Europe as well as in America. As a result high voltage machines are being bought and are being used by untrained men, and without sufficient study and control.

Unless the radiation treatment is undertaken with due consideration as to its applicability in the individual cases; unless it is planned so as to do as little harm as possible to the healthy tissues and yet be sufficiently destructive to the malignant disease, and unless the radiation is carefully measured so as to do no harm by using too much, or too little, the excellent progress which has been made will go for naught and fear on the part of the laity and condemnation on the part of the profession will again retard progress in this most important branch of medicine.

In Europe, careful measurements with the ionization chamber, or iontoquantimeters of various types, are made of each tube and each machine once each week. A half day is usually given up to this work, or a physicist makes the measurements at odd times when the machine is not being used clinically. This is good, but it would be better if such measurements could be made daily or even before each treatment. With the iontoquantimeters this is not practical, because of the time consumed, because of the cumbersome apparatus and arrangements, and because of the undue exposure of the operator.

Not only should the quantity of radiation be measured, but the quality as indicated by the wave-length of the radiation is of equal importance. Both the quantity and quality of radiation differ with different types of apparatus of different makes and involving different principles, and they differ even with the same make. I have two ten-inch machines of the same make which with the same parallel spark length and the same milliamperage differ by 15 per cent in the quantity of radiaton when measured by the ionization chamber and when both are running as nearly perfectly as is possible. Therefore, while formulae giving spark length, milliamperes, time, distance and filter are valuable, one must not be too dogmatic as to their exact value.

Fortunately Professor Duane, one of the Honorary Fellows of this Society, has developed for us a method of measuring the wave-length, which is practical and can be used by any member of this Society in his practical work, and in this way he can know definitely the quality of radiation being used. This method [1, 2, 3] has been described by Professor Duane in three papers read before the American Roentgen Ray Society at Cleveland in 1914, Atlantic City in 1922, and at Los Angeles in 1922, in which papers he described the progress made. The method consists in the measurement of the fraction of the radiation that passes through a given thickness of copper or aluminum. A curve has been published [2] giving the effective wave-length which determines the fraction of radiation that will pass through a given thickness of aluminum or copper. The fraction of the radiation that passes through the filter may be measured either by the photographic method or by the ionization method.

Professor Duane has also developed an ionization chamber which can be used for measuring the quantity of radiation which passes through copper or aluminum and thus one can determine the effective wave-length as indicated above. It can also be used for measuring the total quantity of radiation which is applied to the patient.

The ionization chamber (Fig. 1) is connected with a delicate galvanometer of the d'Arsonval type (Figs. 2, 3 and 4). Both of mine now measure one twenty-eight billionth of an ampere. The ionization chamber is standardized in terms of a certain unit of radiation. This unit of x-radiation is of such intensity that it passes one electrostatic unit of current in each cubic centimeter of the air through which the beam of rays passes.

The standard cell when connected with the galvanometer will give a reading on the scale corresponding to one electrostatic unit of radiation or a definite percentage of such a unit. For instance, in one of my outfits the standard cell gives a reading of one full unit. In the other the outfit is more sensitive and the cell gives a reading of only 0.2 of a unit.

One electrostatic unit of radiation indicates the amount of radiation which will ionize each cubic centimeter of air in the beam of rays so that it will permit the passage of one electrostatic unit

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 7, 1922.

of current. An electrostatic unit is defined as that quantity of electricity which raises a sphere of a radius of 1 cm. to the unit of potential, that is, 300 volts. According to Kohlrausch, it is expressed with a small "e". One electrostatic unit of current equals one electrostatic unit of charge per second. The number of electrostatic units of current multiplied by the number of seconds equals the number of electrostatic units of charge in the period of time.

Therefore, the number of electrostatic units of radiation (indicated by a capital letter E, as suggested by Professor Duane) if multiplied by the number of seconds during which the radiation is applied equals the corresponding number of small "e" as indicated by Professor Friedrich.

Professor Duane has expressed to me privately that the number of "e" units as published in Professor Friedrich's book should be multiplied by ten, or that a cipher should be added At least he is of the opinion that radiation measured by the Friedrich method should give 1700 "e" where 170 "e" is indicated, etc. If this reading is given, then the Duane method and the Friedrich method give absolute units that correspond fairly well in their biological effect, and one should be able to interpret one value into the other.

Practical Applications of the Duane Method

With the outfit properly installed in practical work, one makes a test as follows: (1) Note the presence of any leakage by connecting the galvanometer in the circuit with both the standard cell and the ionization chamber out of the circuits. (2) Connect the standard cells into the circuit and take note of the number of millimeters that the indicator moves on the scale and thereby the number of millimeters that indicate one electrostatic unit of radiation. (3) Disconnect the standard cell and note that the indicator returns to the starting point. (4) Connect the ionization chamber in circuit and note no leakage (no movement of the indicator on the scale). (5) Place the ionization chamber in the beam of rays to be measured and note the number of millimeters of movement from the starting point. (6) The number of millimeters of movement of the indicator on the scale when the ionization chamber is in the circuit used as the numerator, and that of the standard cell used as the denominator will indicate the number, or fraction, of electrostatic units of radiation at the time of reading. All of these steps can be taken within five minutes. (7) Granting that the radiation is uniform and constant, then the fraction of E.S.U.R., as measured in electrostatic units of current, indicated by "E" multiplied by electrostatic units of charge or the number of seconds during which the radiation is effective gives the number of "e" given in any treatment.

In a similar way one can measure the fraction of radiation passing through a millimeter of copper and obtain the wave length used, by the scale given in

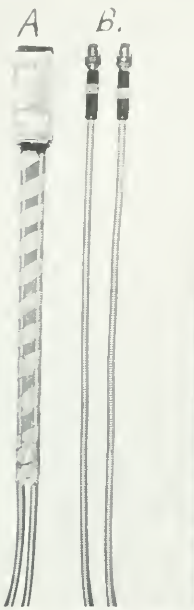
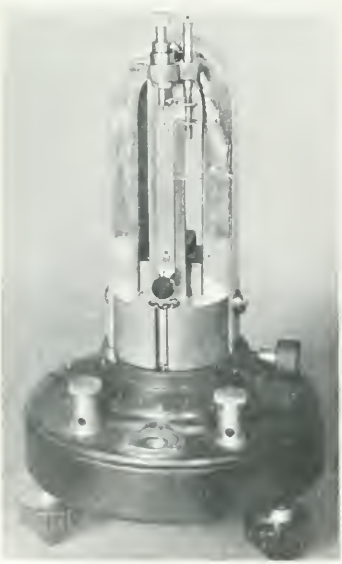


Fig. 1—Showing the ionization chamber "A", and the plugs "B", which are inserted into the sockets in any room containing a machine to be measured.
Fig. 2—Showing the galvanometer without the reflecting mirrors and the scale.



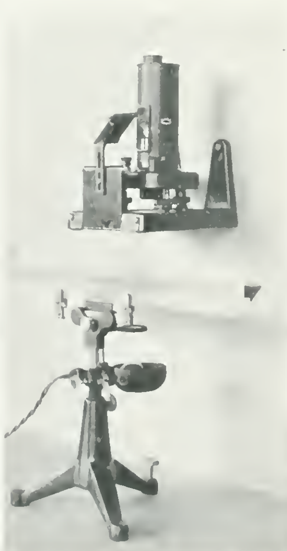


Fig. 3—Showing interior construction of the galvanometer
Fig. 4—Showing the galvanometer set up with the reflecting mirrors and the scale. The galvanometer should be at least one meter above the scale.

Figure 5. Then one can measure the output of the tube and apparatus before beginning treatment, so as to know whether it is up to the standard. During the treatment one can simply place the ionization chamber in the beam of rays and note that the radiation is or is not uniform. One can also place the ionization chamber on the opposite side of the part being rayed and note how much radiation comes through. One can also place the ionization chamber in a phantom and make actual measurements under varying conditions.

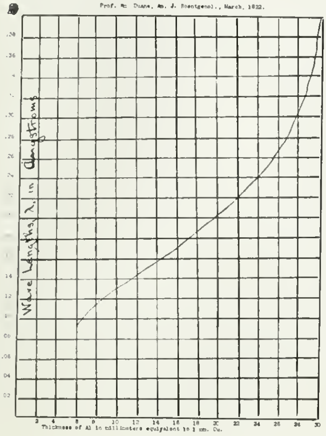


Fig. 5

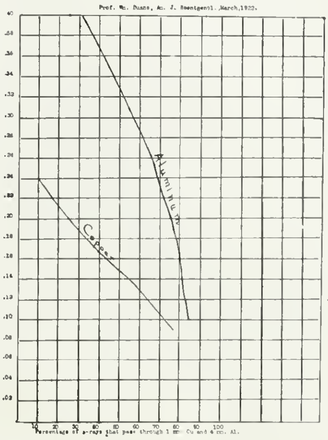


Fig. 6

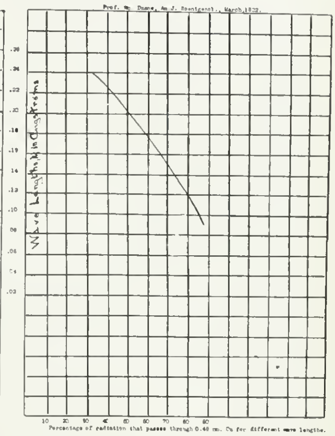


Fig. 7

It was found more convenient to measure wave-lengths by adding 0.5 mm. of copper to the filter which is left in place during the treatment, than to use a millimeter of copper. Therefore, Professor Duane has prepared a scale for direct reading on this basis. He first carefully measured the supposedly 0.5 mm. of copper which I was using as a filter, and measured it exactly. It was found to be 0.48 mm. This is a copper filter obtained from the Victor Electric Company about April, 1922. On the basis of measuring the rays which pass through 0.48 mm. of copper he prepared a scale for direct reading (Fig. 7).

In practical work, one places the ionization chamber about 10 cm. beyond the filter of whatever kind one is using (0.48 mm. Cu plus 1mm. Al) with the voltage and milliamperage constant, and at the working standard one reads the number of millimeters of movement of the indicator on this scale. Then the second layer of 0.48 copper is added and likewise covered by the 1 mm. aluminum and a second reading is made. The first record through 0.48 copper plus 1 mm. aluminum is the denominator of a fraction and the second reading through 0.48 mm. Cu + 0.48 mm. Cu + 1 mm. Al is the numerator, which, when reduced to percentage can be applied to the scale, and the wave-length recorded. This should not take over five minutes and involves no personal exposure to the rays.

With the above method the lower voltage machines can also be measured, both as to their output and to the wave-length. The effective wave-length with a nine-inch parallel spark between points and with 6 mm. aluminum is about 0.23 Angstroms, while with the higher voltage machines and 200 kv. the wave-length is approximately 0.17 Angstroms, when filtered through 0.48 mm. Cu and 1 mm. Al as indicated above.

Much experience will be needed until the biological values can be established, but with the above wave-length, 0.17 Angstroms, the erythema dose is between 1700 (?) e and 2300 (?) e. We will probably find that the quantity of radiation as measured by "e" units will vary with the wave length. Certainly we can draw no conclusions on this point until we have had more experience in the practical application of these methods.

Under these conditions and by these methods we have measured the International Machine and the Reiber Booster now in use in my offices.

THE INTERNATIONAL MACHINE

With a voltage of 200,000, 4 milliamperes, at a distance of 62 cm., with a field 16 by 20 cm., and a filter of 2 mm. glass, 1 mm. copper, and 1 mm. aluminum, the indicator moved to a point 27.75 beyond zero when one electrostatic unit of radiation (as determined by the standard cell) corresponded to 92 mm. on the scale and when the effective wave length measured 0.165 A.

Under like conditions with the Rieber Booster, but running with 210,000 volts instead of 200,000, there was measured on the scale 23.13 mm., or 83 per cent of the radiation given with the International. Therefore, when one makes allowances for the voltage, the Rieber machine is about 20 to 25 per cent less efficient when working under like conditions. This does not condemn the Rieber Booster, for the tube seems

FIGURE 8

Cm. Depth	Mm. on Scale	E. S. U.	Per Cent	Loss in Tissue
0	37	.4000	100	..
1	34	.3700	92	8
2	31	.3400	85	7
3	28.75	.3125	78	7
4	26	.2861	71	7
5	23.57	.2562	64	7
6	21	.2285	57	7
7	18.57	.2019	50	7
8	16.37	.1760	44	6
9	14	.1532	38	6
10	12	.1300	32	5
11	10.75	.1175	28	4
12	9.03	.0982	24	4
13	8.28	.0895	21	3
14	7.14	.776	19	2
15	6	.0652	17	2

Fig. 8—**International Machine, October 3, 1922:** Distance 62 cm. Filter: 1 mm. Cu + 2 mm. glass + 1 mm. Al. Field: 16x20 cm. 1 E.S.U.R. = 92 mm. on scale. Voltage 200,000, 4 ma. No water, 30 E.S.U.R. under water.

FIGURE 9

Cm. Depth	Mm. on Scale	E.S.U.R.	Per Cent E.D.	Loss	Time E.D.
0	33.20	.3334	100	0	118 min(113)
1	31.61	.3327	95	5	
2	28.44	.30	86	9	
3	25.72	.27	77	9	
4	22.72	.2391	68	9	
5	20.11	.2117	60	8	
6	17.50	.1842	52.5	7.5	
7	15.44	.1625	46.5	6	
8	13.66	.1438	41	5.5	
9	11.72	.1233	35.5	5.5	
10	10.33	.1087	31	4.5	
11	9	.0937	27	4	
12	7.77	.0818	23	4	
13	6.55	.0690	19.5	3.5	
14	5.37	.0565	16	3.5	
15	4.66	.049	14	2	

Fig. 9—**Rieber Machine, October 21, 1922:** Distance 62 cm. Filter: 2 mm. glass + 1 mm. Cu + 1 mm. Al. Phantom water 25x25x20 cm. Field: 12x16 cm. 1 E.S.U.R. = 95 mm. on scale. Kv. 210 (Equals 105% of 200 kv.), 4 ma. No. water 24/95 E.S.U.R. = 0.25. Water phantom adds 38%.

12x16 cm. = 33 min. 100% = E.D. 118 min. { 10 cm. = 31%, 15 cm. = 14% }

25x25 cm. = 35 mm. = 105% = E.D. 112 min. { 10 cm. = 37%, 15 cm. = 17% }

16x20 cm. = 34 mm. 102% = E.D. 115 min. { 10 cm. = 25%, 15 cm. = 12% }

FIGURE 10

Cm. Depth	Mm. on Scale	E.S.U.	Per Cent	Absorption
0	60.43	.6498	100	..
1	54.80	.5892	91	9
2	50.40	.5419	83	8
3	46.20	.4964	75	8
4	41.00	.4401	67	8
5	35.66	.3834	59	8
6	31.00	.3333	52	7
7	27.20	.2903	45	7
8	23.40	.2516	39	6
9	20.20	.2172	33	6
10	17.50	.1882	28	5
11	15.20	.1634	24	4
12	13	.1396	20	4
13	11	.1183	17	3
14	9.40	.1011	15	2
15	8	.860	13	2

Fig. 10—**International Machine, September 22, 1922:** Distance 62 cm. Filter: 2 mm. glass + 0.5 mm Cu + 1 mm. Al under 20 cm. water. Field: 12x16 cm. 1 E.S.U.R. = 93 mm. on scale. Voltage 200,000, 4 ma.

to take the current much more easily for some reason, and I feel certain that we can increase the voltage or the milliamperage sufficiently to bring the total radiation value to an equal amount.

It does illustrate, however, that one cannot simply speak of voltage, milliamperage, etc., and be sure that the total radiation is the same when using similar factors.

Both Dr. Bachem and myself found similar differences in the lower voltage machines, amounting to from 15 to 25 per cent, and yet we made our measurements by different methods. So, too, by the Duane method, I have found that there was an improvement of from 10 to 15 per cent in efficiency of radiation output when the uneven mica separators in the commutator were dressed.

Phantom Measurements
(Figures 6, 7, 8 and 9)

Probably the most interesting measurements from a practical standpoint are those made in a water phantom. For this purpose we use an aluminum tank 25 by 25 by 25 cm., the aluminum being 1 mm. in thickness. The tank was filled with water to a depth of 20 cm. This will duplicate the average conditions found in a patient whose abdomen we treat.

We found that the addition of this water phanton increases the radiation 38 per cent in the surface dose as compared with no phantom, the other conditions remaining the same. At a depth of 10 cm. with the International machine running at 200 kv., 4 ma., 62 cm. distance, a 16 by 20 field, filter 1 mm. Cu plus 2 mm. glass plus 1 mm. Al, we obtain 32 per cent of the surface dose. Under like conditions the Rieber Booster gave 31 per cent at a depth of 10 cm. This is very much less than is indicated by the Dessauer charts, or by Dr. Bachem's measurements. Dr. Bachem measured the International with 1 mm. Cu plus 2 mm. glass at a distance of 50 cm., 200 kv. and 4 ma. and he found 41 per cent of the surface dose at a depth of 10 cm. This percentage was obtained by calculation based upon the coefficient of absorption of water. It seems that he and Dessauer are therefore ignoring the effect of the secondary radiation on the surface dose. If I ignore this effect and take the radiation as measured independently of the body or water phantom, 24/95 E.S.U.R. as 100 per cent, then the depth value 12/95 will be 50 per cent of the surface dose at 62 cm. This will then be in excess of their measurements. I believe, however, that this is not correct and that we have no right to ignore the effect of the secondary radiation on the surface, any more than we would ignore its effect on the depth dose.

When 0.5 mm. Cu is used as filter instead of 1.01 mm. Cu, one obtains, with the International, 28 per cent of the surface dose at a depth of 10 cm., distance 62 cm.; and with the Rieber Booster 26 per cent of the surface dose at a depth of 10 cm. with a target surface distance of 42 cm.

Influence of the Size of the Fields on the Surface Dose

Another interesting observation was the effect of the size of the portal of entry upon the surface dose. We have heard much about the effect of the size of the field or portal of entry upon the depth dose, but I can recall no mention of a similar effect upon the surface dose; yet we should have expected this had we given it thought before. The body when radiated sends secondary radiations to the surface just as it does to the depth.

In measurements made upon the Rieber Booster, with the water phantom as above, at 62 cm. distance, 210 kv., 4 ma., 1 mm. Cu plus 2 mm. glass plus 1 mm. Al the effect of the size of the field is as follows:

Size of Fields in Cm.	Percentage	Erythema Dose	Intensity at Depth 10 Cm.
8x12	90%	130 min.	25% of surface intensity
12x16	100%	118 min.	31% " " "
16x20	102%	115 min.	33% " " "
25x25	105%	112 min.	37% " " "

With similar conditions, but with 0.5 Cu filter instead of 1.0 Cu and at 42 cm. distance instead of 62 cm. the Rieber Booster gives:

Size of Fields in Cm.	At Surface	Erythema Dose	Intensity at Depth 10 Cm.
8x12	76%	62 min.	26%
12x16	100%	47 min.	26%
16x20	105%	45 min.	30%
25x25	114.5%	41 min.	34.5%

FIGURE 11

Cm. Depth	Mm. on Scale	E.S.U.R.	Per Cent	Absorption	Time.
0	76.00	.8000	100	..	47 min.
1	66.20	.6968	87	13	..
2	58.60	.6168	77	10	..
3	53	.5577	70	7	..
4	46.48	.4842	60	10	..
5	40.50	.4263	53	7	..
6	35.50	.3737	47	6	..
7	30.60	.3231	40	7	..
8	26.80	.2821	35	5	..
9	22.60	.2379	30	5	..
10	19.70	.2073	26	4	..
11	16.70	.1758	22	4	..
12	14.10	.1484	18	4	..
13	11.80	.1242	14	4	..
14	9.60	.1010	12	2	..
15	7.40	.0779	10	2	..

Fig. 11—**Rieber Machine, October 21, 1922:** Distance 42 cm. Filter 0.5 Cu + 2.5 mat. + 1 mm. Al. Fields: 12x16 cm.; 20x25x25 cm. water. 1 E.S.U.R. = 95 mm. on scale. Kv. 210, 4 ma.

$$12\text{x}16 = 76 \text{ mm.} = 100\% \begin{cases} 47 \text{ min.} = \text{E.D. } 100\% \\ 10 \text{ cm.} = 26\% \\ 15 \text{ cm.} = 10\% \end{cases}$$

$$25\text{x}25 = 87 \text{ mm.} = 114.5\% \begin{cases} 41 \text{ min. E.D. } 100\% \\ 10 \text{ cm. deep} = 34.5\% \\ 15 \text{ cm. deep} = 16\% \end{cases}$$

$$8\text{x}12 = 76\% \left\{ \begin{matrix} \text{E.D.} = 62 \text{ min.} \\ 10 \text{ cm.} = 26\% \\ 15 \text{ cm.} = 10\% \end{matrix} \right\} \quad \left\{ \begin{matrix} 58 \text{ min.} \\ 15 \text{ mm.} \\ 6 \text{ min.} \end{matrix} \right.$$

$$16\text{x}20 = 105\% \left\{ \begin{matrix} \text{E.D.} = 45 \text{ min.} \\ 10 \text{ cm.} = 30\% \\ 15 \text{ cm.} = 12.5\% \end{matrix} \right\} \quad \left\{ \begin{matrix} 80 \text{ mm.} \\ 34 \text{ mm.} \\ 10 \text{ mm.} \end{matrix} \right.$$

Distance 42 cm. 12x16 cm. No cushion = 78 mm. = 100%
Distance 42 cm. 12x16 cm. Mattress 25 cm. = 76 mm. = 97.5%
Mattress absorbs 2.5%

Unfortunately, this whole method of measurement is still in process of development for practical use. We have had to make modifications to eliminate leakage, and there has been much difficulty with the galvanometer. This galvanometer is so delicate that the small suspended mirror dances whenever a heavy wagon passes on the street, and on two occasions the filament supporting the mirror has been broken. In one instance it was broken within 48 hours after being in place, and before any current was passed through it by us. Other repairs have had to be made on three occasions. However, these are difficulties which are to be expected in the development of a new method and they will be overcome. As a whole, it impresses me as one of the most valuable advancements that has been made for practical use.

It is these difficulties that have prevented me from making more observations. Therefore, I am drawing no conclusions at the present time.

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X-Ray Treatment of Tumors*

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DURING the past eleven months some three hundred cases of malignancy involving various parts of the body have been treated by the writer, using a voltage of 200,000. These three hundred cases included early and late malignant conditions of the breast, uterus, pancreas, urinary bladder, stomach, lungs, esophagus, bones and mediastinum.

In some cases the response has been very favorable, while in others no improvement has been noted. It seems that if any benefit is to be derived it usually follows the initial series. In our experience, when treatment is scattered over a period of at least a week patients have much less general reaction than when subjected to the intensive method and the series completed in one day. The general discomfort, nausea and vomiting that usually follows the intensive method is of very little consequence when the series is divided into smaller doses spread over a week or ten days.

In treating malignancy, we have tried to consider each case individually, getting away as much as possible from a routine method. Each case presents some distinct features which should be carefully considered before treatment is started. It has been our plan to have the patients in the hospital twenty-four hours beforehand. A complete physical examination is made and the blood is thoroughly investigated. The night before treatment a cleansing enema is given. The administration of one dram of soda bicarbonate in a glass of cold water three times a day during treatment is the usual procedure. Patients are required to fast six hours before treatment, and no solid food is given for three hours afterward.

A careful estimate is made of the depth of the lesion, as well as a study of its anatomical relations. In dealing with localized lesions every effort is made to avoid normal structures as much as possible. In the presence of general carcinomatosis, this becomes practically impossible; in such cases, a general irradiation of the entire part is indicated.

It has been extremely gratifying to observe improvement in patients with spinal metastasis, secondary to carcinoma of the breast. The following cases will serve as illustrations:

Case No. 1: This patient was a woman thirty years of age, operated on five months previously. At the time of treatment there was extensive metastasis into the dorsolumbar spine and ribs. Owing to the severe pain in the dorsal spine an opiate was necessary before she could be moved to the x-ray department. The patient was suffering from a complete paraplegia, with retention of urine and loss of control of the bowels, and because of her condition only the dorsal surface of the chest and abdomen was radiated. Since the patient was unable to change her position, the dose was kept well below the point of skin reaction, so as to avoid the complications incident to bed sores. Four months have elapsed since the last treatment and she is now able to

*—Read at the Annual Meeting of the Radiological Society of North America, Dec. 6, 1922.

walk with the aid of a cane, and suffers practically no pain. The course of treatment was distributed over a period of three weeks. At the end of the first week she was able to move her toes, and catheterization of the bladder was no longer necessary.

The second case is that of a woman of 50, operated on four years ago for carcinoma of the breast, with extensive metastasis involving the entire spine. At the time of treatment she was developing cord symptoms and having severe pain in the dorsal and lumbar regions. The treatment was more thorough than in the first case, both the dorsal and ventral surfaces of the thorax and abdomen being radiated. It has been five months since the last treatment, and the process has been held in abeyance. During those five months, she has gained fifteen pounds in weight, now attends to her own housework, and is apparently quite well.

In pulmonary metastasis following primary breast cancer very little has been accomplished, even in a palliative way. The patients seem to become progressively worse, with no diminution in the amount of pain. After treatment a hacking cough develops and patients complain of tightness in the chest, accompanied by a burning sensation. The larger the dose, the more profound is the general reaction. Some ten cases have been treated, using both large and small doses, delivered in from two to fourteen days. The results have been essentially the same. However, the general reaction seems more severe when the entire dose is crowded into a period of two days. The nodules in the lungs are very resistant, and the patient's general condition shows no improvement. For weeks following treatment there is a general loss of ambition, accompanied by severe pain in both lungs with great difficulty in breathing.

In secondary sarcoma of the lungs, temporary relief can be obtained by the use of higher voltage. The nodules seem to become smaller, and in some instances entirely disappear. Accompanying the diminution in size of the nodules there is concomitant improvement in the general health, and in many instances the pain entirely disappears. These patients seem to do better when treated with small doses at frequent intervals, and the general reaction is practically negligible.

Some two years ago, I was called upon to treat a woman 30 years of age, with metastatic sarcoma of the lungs, secondary to sarcoma of the ischium, microscopically confirmed. Roentgenograms showed a definite lesion involving the right ischium. Invasion of the bone cortex was definitely established. In both lungs there were many nodules from one to four centimeters in diameter. During the previous three months she had lost thirty pounds in weight and frequent administration of morphine was necessary to control pain. The ischium and lungs were treated for three months by the older methods then employed, using a voltage equivalent to a nine-inch spark gap with 6 mm. Al as a filter. Nevertheless, the patient's condition became steadily worse. The technique was then changed; the voltage was increased to 160,000 filtered through 0.5 mm. Cu. With the above mentioned factors, half hour sessions were given at weekly intervals, and in the course of a month, the patient's general condition seemed to have improved. During the following six months, there was a gradual improvement with a gain in weight of some forty pounds. The pain was kept under control, the morphine was discontinued, and the nodules in the lungs became a great deal smaller. This scheme of treatment was continued for the next eighteen months and the patient remained quite well until the first of November, 1921. Then severe pain in the chest developed, accompanied by rapid loss in strength, confining her to bed and she died during the second week of December. In this case, the x-ray certainly controlled the pain, and it seems reasonable to believe, greatly prolonged life.

On March 8, 1922, there was referred for treatment a young man 27 years of age, with sarcoma of the lung, secondary to sarcoma of the testicle. When operated on three months previously, roentgenograms had revealed no metastasis in the lungs. At the time of treatment, the left pleural cavity contained a large quantity of fluid, practically obliterating the entire left chest. This had been aspirated several times, and bloody fluid removed, but the cavity refilled rapidly. During the folowing week the patient's chest was radiated anteriorly and posteriorly, receiving a total of 1200 ma. min. at 200 kilovolts with 1 mm. Cu and 1 mm. Al as a filter. Following the initial series, the pleural sac was again aspirated, and a large nodule involving the lower lobe of the left lung was then discernible. On March 25th, the patient was discharged from the hospital, and returned to his home in Michigan, where he remained for the following month. During this time there seemed to be no increase in the amount of fluid in the pleural cavity. The patient returned to the hospital for further treatment, on April 27th. Roentgenograms then showed no fluid in the pleural cavity, and diminution in the size of the nodule. The chest was again radiated, giving one thousand ma. min. For the following four weeks the patient's condition seemed to improve, and there was a general feeling of well being. He had no pain, and respiration was quite normal. On May 26th it was deemed necessary to give further treatment; in the left supraclavicular space there was a mass about the size of a lemon, which had developed during the previous week. Under treatment, this tumor responded readily, and in one week had decreased to the size of a hickory nut. The chest examination at this time seemed quite encouraging; no fluid was present in the left pleural sac, and the nodule in the lung was very much smaller. During the last course of treatment the patient complained at various times of severe pain in the head; this became progressively worse during the following month and morphine was necessary to produce sleep. During the first week of July the patient went into coma and died one week later. No autopsy was obtained. However, death was thought to be due to cerebral metastasis. In this case also it would seem as if great benefit was derived from the x-rays. After one course of treatment the fluid in the chest did not reappear, the pain was negligible, and the nodules greatly diminished in size.

Three cases of carcinoma of the stomach are included in this series. One of the cases had been explored at the Mayo Clinic nine months previously, and an inoperable carcinoma of the pylorus was encountered. The patient has received two series of x-ray treatments, of moderate dosage, without any systemic reaction. Since the first treatment, eight months ago, he has gained twenty-five pounds in weight and he is now symptom free. The blood is practically normal, with 4,500,000 reds and 95 per cent hemoglobin. At this time, November 20th, the patient has regained his normal weight, and has resumed his occupation as a printer.

The second case has not done so well, due to the extreme radiation sickness which followed each treatment. It has been impossible to finish the course started two months ago. After each treatment the patient complained of excessive vomiting, and for a period of three or four days afterwards was unable to retain even liquids. There was rapid loss of weight and strength. On this account it was deemed advisable to discontinue treatment.

The third case, a man of 60, with a small carcinoma of the pylorus, was referred for treatment preparatory to resection. The treatment was distributed over a period of ten days, through three portals of entry, viz., anteriorly, posteriorly and right laterally, using moderate doses. At no time during treatment did the patient have either systemic re-

action or gastro-intestinal disturbance. Three months have elapsed since the treatment; his general condition is much improved; his appetite is quite normal and he has gained ten pounds in weight. He has been so impressed with this improvement that he has declined operation.

In some twenty cases of carcinoma of the urinary bladder, the results have been uniformly good. The patients have been subjected to large doses and seem to have experienced no serious difficulty. During treatment, pain in the bladder may be increased and there is usually a frequent desire to urinate, accompanied by an irritating tenesmus. These symptoms may continue for a week following the treatment, and then gradually subside. In one case recently treated, the symptoms have been greatly aggravated. Besides a more frequent desire to urinate, there has been pain and hemorrhage. The exacerbation might well be due to frequent instrumentation and the instillation of silver during treatment. The usc of strong solutions on a bladder mucosa already irritated and congested by the x-ray might well account for such unfavorable symptoms. Of late it has been our practice to ask the urologist to withhold instrumentation and instillation until the x-ray treatment is completed.

Two cases treated ten months ago, showing bladder ulcerations cystoscopically (microscopically malignant), have remained well. Eight weeks after the initial treatment the urologist was unable to find any evidence of malignancy. He remarked that he would have been unable to make a positive diagnosis had he not known the patient had had a malignant process.

In mediastinal tumor immediate improvement is the rule. The tumor mass becomes smaller, pressure symptoms subside, and the engorged blood vessels rapidly disappear. Three mediastinal tumors have been treated, and all have been greatly improved. Two of these patients are at present symptom-free, and the mediastinal mass is no longer demonstrable.

The third case has now been treated for over a year and her general condition is quite alarming. The tumor, however, has remained small, but there has not been a concomitant improvement in her general condition. When first treated the mass extended well beyond the sternum and measured twelve centimeters in transverse diameter. The patient was unable to lie prone, dyspnea was pronounced, and the skin was quite cyanotic. The blood vessels over the anterior chest wall were greatly engorged because of circulatory obstruction within the thorax.

After one course of treatment at a peak voltage of 140,000 the tumor mass was greatly reduced, and the superficial vascular engorgement disappeared. This improvement continued for one month, when the tumor again began to grow and the superficial circulation again had to relieve the obstructed deep circulation. Another course of treatment was given at the same voltage, but the mass grew rapidly larger. Frequent examinations were made during the three weeks following the second series, and each time the tumor seemed larger. During the second course, left pleurisy with effusion developed. The patient's general condition became progressively worse and she was referred to Dr. Case, who at that time had a transformer capable of delivering 200,000 volts. Immediately after the third series, the patient's condition rapidly improved. The tumor mass decreased in size, and at the end of two months was no longer discernible; the pleural effusion was gradually absorbed. Four months after treatment at Battle Creek, the patient developed dysphagia, which, on fluoroscopic examination, was found to be due to a tumor pressing on the esophagus. A fourth series was instituted, and the difficulty in swallowing rapidly subsided. During these four courses of x-ray treatment the tumor had been kept quite well under control, but the patient's general condition had become weaker. There had been gradual loss of appetite and marked loss of weight, even under forced feeding the patient was unable to recover lost ground. A month ago she presented herself for further treatment, but after careful examination and consultation we were forced to decline. Is it not possible that in this case we may be dealing with a cachexia, probably due to x-rays? The tumor mass has been controlled, but in its destruction, the patient's general condition has suffered. In the other two cases mentioned the amount of radiation was comparatively small, and the tumor mass was controlled without sacrificing the general condition of the patient.

Therefore, in the treatment of mediastinal tumors, we feel that it is advisable to administer small doses, having the patient return at frequent intervals for careful examination. If on examination the tumor seems to be progressing, a small amount of x-ray may be administered. In the case above reported there is one point of unusual interest, in view of what has been written about the effects of x-rays upon the pleura and lungs. During treatment, the patient developed pleurisy with effusion, which after still more intensive radiation at higher voltage was gradually absorbed.

During the past eleven months, one case of advanced carcinoma of the pancreas has been radiated. When treatment was started the pancreas was greatly enlarged and there was metastasis to the left supraclavicular space. The patient was cachectic and greatly emaciated, and very little was expected even in a palliative way. During the first course the pancreas and chest, including the supraclavicular spaces, were radiated anteriorly and posteriorly. During treatment the patient had considerable nausea and vomiting, at times so marked that treatment had to be interrupted. For six months after the first series the patient's general condition improved and the tumor became smaller. On June 7th she returned for a second course; she said she was much better, and was then quite comfortable and hopeful. The second series was distributed over a period of ten days, and the dose somewhat increased. The blood at this time showed 3,370,000 reds, 5,400 whites and 64 per cent hemoglobin. During this treatment the patient was practically free from any nausea and vomiting and was able to take treatment daily. On June 14th, examination of the stool showed a positive Weber, but this finding was not repeated on successive examinations. On June 17th she returned home and for four weeks seemed to gradually improve. On July 10th she was suddenly seized with sharp abdominal pain, and died in a short time. No autopsy was obtained. The physician in charge attributed her death to the x-ray treatment. It is probably quite natural in such cases for the physician to blame the x-rays, however, it is hardly fair to condemn the method, especially in the presence of such extensive involvement. Death was inevitable, and the most that could be expected was prolongation of life. This, we feel, was accomplished. When the patient presented herself for treatment, she was told we could promise nothing. She replied that if she might live until the first of June, to see her son graduate, she would be quite satisfied.

In dealing with carcinoma of the cervix uteri we have had the advantages of close cooperation with the gynecologists. Results in early cases have been quite satisfactory, while in more advanced cases, with extensive involvement, there has been some improvement in general health and the symptoms have been held in abeyance for a time at least. In a few cases diathermy was used in conjunction with x-rays. One case classified as inoperable and hopeless, was twice diathermized and later subjected to x-ray therapy. Six months have elapsed since the last treatment, and the patient has gained forty-five

pounds in weight. She now claims to feel like a girl of fifteen. The discharge has disappeared and the cervical stump seems quite normal. No bimanually palpable masses can be felt. It seems useless to attempt the treatment of uterine carcinoma by x-rays alone, thus subjecting the bowel and urinary bladder to intensive x-ray crossfire, when by the local application of radium or the use of diathermy the local lesion can be attacked directly. The judicious use of x-rays is indicated in treating adjacent lymph glands and malignant foci too distant to have been reached by radium or diathermy.

Too short a period has elapsed to enable one to state whether or not the improvement in selected cases will be permanent. However, we can say that the immediate results have been better than we anticipated, and certainly surpass anything heretofore accomplished. The improvement in carcinoma of the uterus is probably due to the accessible location of the uterus. The depth being about ten centimeters in the average woman, a great deal of scattered radiation is utilized. The average absorption in the first ten centimeters of tissue is about fifty per cent. It can be readily seen that by using four portals of entry the depth dose can be built well up beyond one hundred per cent of the erythema dose.

In the treatment of bone sarcoma very little progress has been observed. Pain can be controlled, but the effect wears off rapidly and in the course of ten days following radiation the pain again becomes very severe. Practically no regression of the tumor has been evident, in fact, in most of our cases the tumor mass seems to have progressed steadily. In trying to establish a satisfactory technique several methods have been used. In some cases, small doses repeated at short intervals have been given, while in others large doses at one sitting. The results, however, have been uniformly discouraging.

In sarcoma of soft tissues the results have been only fair. Patients not previously operated on seem to do better than those subjected to surgery. A patient with a large round-cell sarcoma involving the fascia of the right thigh was given two courses of treatment. Five months after the first course the mass had diminished from the size of a grapefruit to that of a walnut. The patient's general condition is now very satisfactory and he has resumed his former occupation. Radiographic examination of the lungs and bones shows no evidence of metastasis.

Another patient with a sarcoma of mixed type but with small round cells predominating, had been previously operated on, but the operation had been followed by rapid recurrence. The patient was referred to me on July 6th.

The tumor was located on the posterior aspect of the upper third of the left thigh, but the femur was not involved. The mass was about the size of an orange. The blood on that date showed 4,300,000 red cells, 4,400 whites, and 90 per cent hemoglobin. The differential count was quite normal. The tumor was radiated through four fields, giving in all 1700 ma. min. at 200,000 volts, at a distance of 56 cm. using a filter of 1 mm. Cu. and 1 mm. Al. For two months the patient's condition seemed to improve; pain was alleviated and the growth became smaller. A roentgenogram of the chest at this time showed no evidence of metasatasis. The patient returned for further treatment September 4th, and 2800 ma. min. were given through four fields, using the above mentioned factors. For a month following treatment the condition seemed under control and the tumor was appreciably smaller. On November 10th, two months after the second course, the mass began to grow very rapidly, and severe pain in the abdomen developed. X-ray examination of the lungs showed no definite metastatic nodules. On January 3rd, the patient died of peritonitis. Autopsy revealed a perforation of the ileum. No metastasis was found in the lungs or abdominal viscera.

In treating carcinoma of the breast, at high voltages, we have noted very little improvement over the older technique. However, we do not believe that the x-rays are at fault, but rather that our method of administration is not correct. In breast carcinoma a technique similar to that used in carcinoma of deep structures is not applicable to comparatively superficial lesions. No one technique will apply to all cases, nor be applicable to all types of malignancy. The therapeutic value of x-rays depends upon the amount of rays absorbed by the tissues; therefore, the dose is the difference between the amount delivered to the skin and that which goes through the body. For example: If 100 per cent is delivered to the skin, and at a depth of five centimeters 60 per cent is delivered, the dose is, therefore, the difference between 60 and 100, or 40 per cent the amount absorbed in the five centimeters. Carcinoma of the breast is a comparatively superficial lesion, being located, as a rule, not more than three inches from the skin surface. We have found (using beef for the experiment) that only thirty per cent of the x-ray beam, measured by the iontoquantimeter, is absorbed in the first two and one-half inches. With the technique commonly used throughout the United States, the greater part of the x-ray beam is absorbed in the deeper normal tissues. The majority of roentgenologists have been treating carcinoma of the breast through two fields, viz., anteriorly and posteriorly. In treating posteriorly, the target-skin distance has been increased to seventy-five centimeters. Even with the increase in distance, only about 20 per cent of the skin dose is delivered to the area of pathology. Even when the treatment is given from two directions it can readily be seen that the radiation absorbed by the tumor mass is well below 60 per cent. With the above technique, we have observed in a great many cases, multiple recurrences immediately under the skin. Of late, we have tried by the use of paraffin, bread dough and sheeting, to convert comparatively superficial lesions into deeper ones. By this method it is possible to increase the absorption in the first three inches of tissue to about forty per cent. The scattered radiation given off by such artificial media is also utilized. In experimental work it has been found that ten per cent of the x-ray beam is absorbed in five inches of sheeting. By using bread dough mixed with some antiseptic preparation, which can be easily moulded to the breast, the tumor mass can be readily converted into a deep lesion.

It has been contended by many roentgenologists that the lungs should be treated in all cases of carcinoma of the breast, because of potential involvement. This view seems too broad, and in many cases of breast cancer, pulmonary metastasis cannot be demonstrated. I recently saw a patient who had been operated upon twenty-one years ago for carcinoma of the breast. It does not seem probable that this patient had metastasis to the lungs at the time of the operation. One can recall many cases well fifteen years after operation. It must again be emphasized that each case should be treated as a special entity; no routine technique is adaptable to all cases. Having used the higher voltage in a great many cases of carcinoma of the breast with discouraging results, I have found it advisable to return to a medium voltage. Inasmuch as the pathological process is quite superficial, it seems reasonable to believe that the x-rays of softer quality, and absorbable in the first three inches, will produce better results. I have recently adopted a technique similar to that used by Dr. Pfahler, using 125, 000 volts, filtered through 6 mm. Al and a target-skin distance of 15 inches. With these factors a distinct tanning can be produced in thirty minutes. The breast is divided into as many areas as possible, using the cross-fire method. Patients with cutaneous or subcutan-

eous recurrences are, in some cases, treated with a seven inch gap, without filtration. The technical details are made to conform to the individual case.

I have recently treated a patient with a pitutiary tumor. At the time there was optic atrophy, with practically complete loss of vision. The patient complained of severe headache and nausea recurring at frequent intervals. Roentgenologic examination of the skull revealed complete destruction of the clinoid processes, and erosion of the base of the sella. In the region of the pituitary fossa there was an indefinite shadow which was thought to be cast by a tumor. The patient came for x-ray treatment August 29th. A comparatively small dose was given at 200 kilovolts, through the right side of the head, directly over the pituitary gland. The two following days, small doses were given through the left side of the skull, and through the roof of the mouth, directed to the tumor. Immediately after treatment, there was considerable nausea and vomiting, and the pulse rate fell to sixty. These symptoms continued for two days, after which they subsided, and for a period of two months the patient felt well. When he returned for examination and treatment, late in October, the symtoms had reappeared, and he was anxious to have further treatment. At this time a larger dose was given through two fields over the right and left side of the skull. Following the treatment, the patient's condition became quite alarming. The pulse became unusually slow and irregular, and there was profuse projectile vomiting. This situation continued for a week and the patient was greatly weakened. The increase in dosage may well have accounted for the distressing symptoms; they may have been part of a reaction associated with inflammatory edema, and consequent increase in intracranial pressure. If we are to consider such symptoms at all seriously, it would seem advisable to avoid large doses in pituitary tumors, and the patient should be treated with small doses at frequent intervals.

Conclusion

1. In the majority of cases, even after very large doses, the blood count has remained practically normal; the changes noted usually occurred in the white cells. Immediately after treatment there is a rise in the white cell count, followed by leukopenia lasting about four weeks, and gradual return to normal. The lymphocytes seem more sensitive than the other types of cells. The hemoglobin has shown practically no change in the majority of cases. Patients with blood changes following therapy are usually of the advanced type, cachectic and emaciated. If during treatment such patients suffer from radiation sickness and are unable to take food and water there results dehydration and consequent blood changes. Out of three hundred cases we have found a white count below three thousand in only two. After a rest of five weeks, the counts returned to normal.

2. In all abdominal cases, careful examination of the stool for blood showed positive findings in five only.

3. Only in a small number of cases have we encountered severe diarrhea.

4. Experience has taught us that malignancy makes it impossible to give a definite prognosis, good or bad. Cases that seem hopeless are often greatly improved, while early cases may go on to a fatal termination, uninfluenced by the rays. The best course seems to be to avoid promising patients or relatives anything regarding improvement, even in cases that appear very favorable.

X-Rays and X-Ray Apparatus; An Elementary Course*

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The Gas Bulb

48. The main features of the type of gas tube in most common use for either coil or transformer are illustrated in figure 49. C is the cathode, with face concave or cup-shaped, so that as noted in Section 45, the cathode rays are brought to a focus on the face of the target. From the focus spot x-rays spread out in all directions, passing through the whole half of the hemisphere in front of the plane M F M. Here it may be noted that when the current through a gas tube is in the right direction, the portion of the bulb in front of the plane M F M is usually strongly fluorescent, being separated from the remainder by a sharp line of demarcation. The target T forms the end of a long metal arm A, the anticathode, which by means of the connecting wire W, is in electrical contact with N, the anode. The anode N lies within a short side arm of the tube, and does not project into the main body of the tube. V is another side tube which carries a third electrode E, and is added for the purpose of regulating the gas pressure in the bulb. P represents a rubber tip covering the place at which the tube was sealed off from the exhaust pump after the initial exhaustion has been completed.

Regulation of the Vacuum

49. It will be seen later that the nature of the beam of x-rays leaving a tube depends both on the current, that is, the milliamperage (ma.) and on the voltage across its terminals (the back-up). An operator, therefore, must be able to control both the current and the voltage. Now, if the vacuum remains constant, the higher the voltage applied to a tube, the greater the current through it (see Sec. 52 below). There are cases, however, where an operator may wish to change to a *higher* voltage without altering the milliamperage, or possibly with even a smaller milliamperage. How can this be done? To understand the answer to that question, it is necessary to remember that the voltage required to maintain a given current through an ordinary vacuum tube varies with the pressure of the contained gas. If, therefore, by any means, the gas pressure in any x-ray bulb is altered, a different voltage will be required to pass the same current through it. If the vacuum is lowered (pressure increased), the resistance of the tube decreases or it becomes "softer." If the vacuum is raised, the tube runs "harder", that is, the resistance increases. A soft tube, therefore, is more conducting than a hard one.[1] Putting it in another way, a higher voltage, or a bigger back-up is necessary to maintain a certain milliamperage through a tube when it is hard than when it is soft.

The desired regulation of voltage and current may be obtained (1) by having a series of tubes, for example, one soft, one medium, one hard; (2) by altering the pressure of the gas in a single tube. The first method is to be preferred for tubes which will maintain a fairly constant vacuum (see Sec. 53 below). Since, however, vacuum changes in a tube are ultimately inevitable, method (2) must be used to some extent, even in the case of an outfit which includes a number of tubes.

50. But it is asked, how can one vary the pressure in a tube which is sealed and cut off from any connection with an exhaust pump? Such a variation is possible because all gas tubes are supplied with what are called

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vacuum regulators. Reference will be made to three of these. (1) In the kind in most general use, a side arm, V, (Fig. 49) provided with an electrode

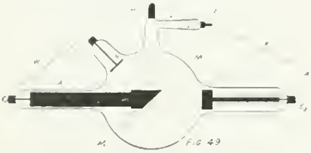

Fig 49

E, and containing some substance such as asbestos wool, charcoal, lime, etc., is sealed on to the tube. Such substances contain a certain amount of "adsorbed" gas, some of which is released when the substance is warmed. The usual method of warming the regulator consists in passing an electric discharge between the electrode E and one of the main terminals of the tube. For this reason, whenever a gas tube is used at any appreciable distance from a transformer or coil, three lead wires are invariably used. A glance at Figure 51 will show the reason for this. In this figure C and D represent the high tension terminals, while AC is a metal rod capable of being rotated about C, but normally in the position shown in the figure. When the x-ray switch is closed, the current passes through the tube circuit and the tube in the usual way. Suppose, however, that by means of a cord R attached to the rod AC, it is pulled aside to the dotted position until the end A touches B, a "binding post" on an insulated support. If, now, B is attached by means of a flexible conducting cord to E, the electrode of the vacuum regulator, it is evident that, on closing the x-ray switch with the rod in this position, the discharge passes through the tube from the vacuum electrode to the terminal E_2. As a result of such a discharge, the substance in the regulator is heated and a certain amount of gas (largely carbon dioxide and water vapour) liberated. As a rule, only a small quantity of gas is required and care must be exercised not to allow such a discharge to pass for any but the shortest intervals of time. If such a precaution is not taken, the pressure may be raised too much, and re-exhaustion of the tube may be necessary.

Occasionally the regulator is used in such a way that, if the tube becomes too hard when in operation, it is auomatically softened. To accomplish this, the third wire is dispensed with and use is made of an adjustable flexible wire X (Fig. 49), permanently attached to the electrode E. Suppose this wire is set with its end A near one of the tube terminals, but at such a distance that no spark jumps across. It will be seen that (provided the distance A to E_2 is not too great), if the tube should harden appreciably when in operation, the higher voltage across the tube will cause a spark to jump this gap, thus sending a discharge through the regulator. Gas will then be liberated, the tube will be softened, the voltage across the tube will drop and sparking A to E_2 will cease.

The vacuum regulator we have been discussing is of use only in lowering the vacuum. Suppose the pressure in a tube is too high, how can it be reduced (that is, the vacuum *raised*)? This can be done to some extent in at least three different ways, (1) by operating the tube with small currents until it is quite hot, (2) by setting the tube aside for some length of time, (3) by cooling the vacuum regulator. As noted in Section 54 below, a tube hardens when in use because of the adsorption of gas by the glass walls, the metal electrodes and possibly the regulating substance itself. The hardening because of method (2) simply means that this absorbing process increases with time. In the case of regulators containing some hygroscopic substance such as asbestos packing, method (3) has been used with success by Levy and Mann[2]. These workers have shown that with such regulators, tubes may be conveniently hardened by cooling the regulator by means of an ethyl chloride spray. For exact details of using this method, which is extremely simple, the reader is referred to the original article. The method is based on two sound scientific principles. (a) Water vapor in an enclosed vessel will condense until it has the equilibrium pressure corresponding to the lowest temperature of any part of the vessel. In this case the regulator tube becomes coated with snow and ice. (b) The adsorption of gas, at least in the case of many substances, increases with decreasing temperature. Research workers when using apparatus in which a high vacuum is necessary, frequently attain the required low pressure by attaching to their apparatus a tube containing cocoanut charcoal immersed in liquid air. At the low temperature of liquid air the absorption of the charcoal is very great.

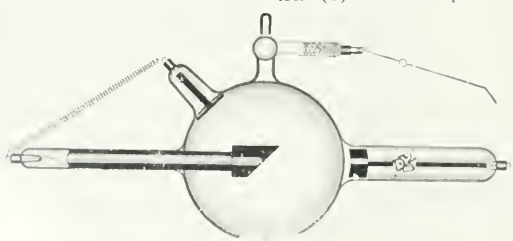

Fig. 50

It is desirable, however, to have a tube too hard rather than too soft, for, as noted above, the remedy for too great softness is re-exhaustion.

In this connection attention may be called to an article by Mutscheller[3] in which he describes a gas tube with a somewhat new type of regulator. To begin with, use is made of a new substance which consists of a mixture of nitrides of metals such as thorium, aluminum, barium, etc., and, it is claimed, has the property not only of liberating nitrogen when warmed by a discharge in the usual way, but also of absorbing or "adsorbing" nitrogen from its surroundings. With such a substance, therefore, because of this adsorption, the tube on standing automatically returns to the hard state. On each occasion when it is desired to use the tube, it must be softened to the desired degree. To guard against over-softening a device is added, as a result of which, once a certain pressure has been attained in the bulb, the discharge instead of passing from the electrode through the substance, passes from the electrode to a metal cylinder surrounding the substance and then through the main part of the tube. For details, the reader is referred to the original article. In this tube, to which reference will again be made, it is well to note that the residual gas is nitrogen. For the original cut of Figure 52 an illustration of this tube, as well as for Figures 55 and 56 my thanks are due the Wappler Electric Company of New York.

The Palladium Tube

(2) The metals palladium and, to some extent, platinum are porous to the gas hydrogen. Use is made of this property to regulate the vacuum in a gas tube. The device is extremely simple. Instead of the regulator just described the bulb has a side tube somewhat as illustrated in Figure 53. Through one end of this is sealed a palladium tube, with the end inside the bulb open, the end outside closed. To soften a tube with such a device all that is necessary is to place a small flame of burning hydrogen (illuminating gas will do) in contact with the closed end of the palladium tube. Hydrogen will then diffuse inside the bulb. If illuminating gas is used, in order to ensure an excess of hydrogen no air should be supplied the flame.

A palladium tube may also be used to harden a tube, provided it contains hydrogen as the residual gas. To use it for this purpose the external portion of the tube must be warmed in an atmosphere *free from hydrogen.* In this connection reference may be made to the so-called Hydrex tube, which is provided with two palladium tubes, one (A) enclosed in a small bulb containing hydrogen at a pressure considerably greater than that within the x-ray tube itself; the other (B) open to the air. If A is heated, hydrogen passes into the bulb; if B is heated, hydrogen passes out.

The Bauer Valve

(3) This is a third device for softening a tube. By means of it small quantities of air from the surrounding atmosphere may be admitted to the tube. The principle will be understood by reference to Figure 54 (taken from Kaye's *X-Rays).* Connection between an unglazed porcelain tube and the outside air can only be established when the column of mercury, indicated by the black line, moves past P, the junction of the porcelain tube with the mercury column. Normally the air pressure in the chamber C is such that this connection is sealed. If, however, by means of a pneumatic pump (the bulb of a syringe might do), the mercury is forced past the junction, air from the ouside can enter the porcelain tube, and hence diffuse through its pores into the tube. To prevent the passage of mercury vapor into the x-ray bulb, the porcelain tube contains a packing of gold leaf. As the mercury quicklv returns to its normal position, only small quantities of air are admitted at a time.

Rating the Vacuum

51. It will be evident that the terms hard and soft are very general ones. There must be a border line condition, for which one might describe a tube as "not very hard" or "not very soft." It is natural to ask, therefore, if there is not a more exact way of describing the resistance of a tube. It will be recalled that when one is dealing with conductors, such as ordinary wires, filament lamps, etc., their resistance is expressed as so many ohms. With such conductors it is found by experiment that if we take any given resistance, the current through it is always proportional to the voltage across its ends; that is to say, if we double the voltage, the current is doubled; triple the voltage the current is tripled, and so on. As a consequence of this experimental law (Ohm's Law), the number obtained by taking the ratio $\frac{\text{volts}}{\text{amperes}}$ is taken as a measure of the resistance of the conductor. For example, if, when 12 volts are applied to a conductor the current is 2 amperes, the resistance is $\frac{12}{2}$ or 6 ohms. [If 6 volts had been applied, the current would have been 1 ampere].

52. Is there any corresponding way of expressing the resistance (degree of hardness) of an x-ray tube? To answer that question, we must resort to experiment. Suppose, with tube vacuum as constant as possible, we vary the voltage across the tube and for each value note the corresponding current (ma.) through it. Do we find any simple relation between volts and milliamperes? According to the data given in Tables III and IV (a record of some results published by the Wappler Electric Company, and reproduced with their kind permission) there is an approximate law. In Table III, for example, it will be noted that the ratio $\frac{(\text{voltage})^2}{\text{ma.}}$ is approximately equal to 0.9 for all values of the current. This means that if the voltage be doubled, the current becomes four times as great; if trebled, the current will be nine times as great. In Table IV similar readings for a softer tube are given. In this case, the ratio $\frac{(\text{voltage})^2}{\text{ma.}} = 0.6$ approximately, and the same law holds roughly, double the voltage, the milliamperage is four-fold.

TABLE III.—TUBE A

Voltage (in inches gap)	Current (in ma.)	(inches)² gap
6″	40	.90
5″	29	.86
4½″	23	.88
4″	17	.94
3″	10	.90

TABLE IV.—TUBE B

Voltage (in inches gap)	Current (in ma.)	(inches)² gap
5″	40	.62
4″	27	.59
3½″	21	.58
3″	14	.64

The law, however, is not exact, although the figures do establish its approximate truth. Moreover, they show why it is possible to express the degree of hardness of a gas tube by a number, as has been done by the Wappler Electric Company. Tube A (Table III), for example, is said to have a 0.9 vacuum, Tube B (Table IV), a .62 vacuum. To illustrate once more, in this system a tube with a 0.4 vacuum, is one through which a current of 40 ma. is passed when the back-up is 4″.

FIG 51

$\left[\frac{4^2}{40} = .4\right]$. Such a tube is of medium hardness and suitable for all average work. If a tube is hardened so that a back-up of 6″ is required to pass 40 ma., the vacuum is now 0.9, that is $\frac{6^2}{40}$.

As a matter of practice, however, there is not much need for rating the vacuum. An operator soon knows by experience what voltage and milliamperage is required for the particular case in hand, and, will choose his tube accordingly or will regulate the vacuum until the proper combination has been obtained.

Constancy of the Vacuum

53. In radiography it is desirable and in treatment it is highly important that an x-ray bulb should maintain a given vacuum for some length of time. With a tube which has been properly handled, this is the case. When first used, gas is liable to be liberated from the electrodes of a new tube, and the vacuum alters. If, however, care is exercised to avoid initially the use of long exposures and heavy currents, the tube ultimately settles into what is called a "seasoned" condition. "Once a tube is seasoned it will maintain its vacuum and degree of hardness for long periods and may be used for hours daily" (Knox). For that reason it is desirable to have a range of tubes of varying degrees of hardness and to avoid as much as possible the use of the vacuum regulator. But the possession of a range of tubes, all maintaining a constant vacuum, is more or less an ideal state of affairs and vacuum regulators are indispensable. Here again we may refer to the tube with the regulator described by Mutscheller, which, is claimed, makes it possible to adjust a tube to conditions ranging from very soft to very hard. Moreover, once this tube has been set in a given state, a constant vacuum is maintained for all ordinary time intervals required in radiography.

Action of the Tube

54. A vacuum regulator is necessary for another and a very important reason. In the case of a tube which has been in use for some time, two things are observed: (1) the tube gradually

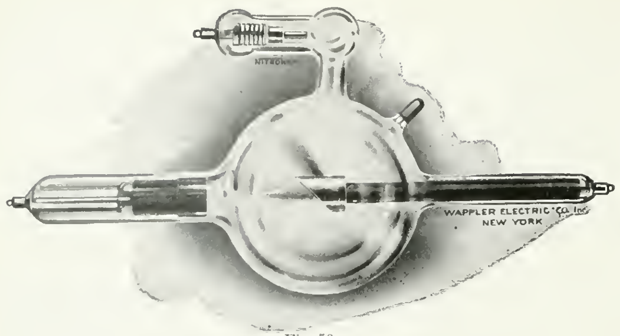

Fig. 52

runs harder; (2) the glass walls of the tube are gradually coated with a black metallic deposit which looks much the same as the black coating often seen on an old tungsten filament incandescent lamp. Now, this gradual hardening is due largely, if not altogether, to the absorption or adsorption of the residual gas by the walls and electrodes of the tube. After a time, therefore, it is absolutely necessary to use some means of letting a little gas in a tube.

The adsorption is increased by the presence of the metallic coating, and herein lies one reason why such blackening is undesirable and should be avoided as much as possible. Three other objections to the presence of blackening may be stated: (1) it increases the resistance of the tube; (2) sparking along the walls rather than through the gas is liable to take place; (3) the danger of puncture is increased. "Experiments in the laboratory have shown that a grounded metal wire can be brought up into contact with a clear bulb when the tube is operating, whereas with a tube having a metal deposit inside, such a wire must be moved away a number of inches to avoid puncturing the tube." (C. N. Moore, General Electric Company).

Causes of the Blackening of a Gas Tube

55. We can understand how best to minimize blackening by noting that it is the result of two causes, (1) the evaporation and disintegration of hot metals; (2) a cathode disintegration known as "sputtering." Sputtering consists of the ejection of metallic particles from the cathode. These particles are small pieces of metal and must not be confused with electrons.

In a good tube, therefore, blackening is minimized, (1) by choosing as metal for the cathode one which sputters a minimum amount; (2) by keeping the tube and especially the metal parts as cool as possible, and so preventing vaporization. Moreover, as the greater the current which is used, the more marked is each of these phenomena, obviously heavy currents should not be used any more than is necessary. In the actual construction of the bulb, however, means are taken to minimize the causes of blackening. These can best be explained by referring briefly to further details in connection with the actual construction of the tube.

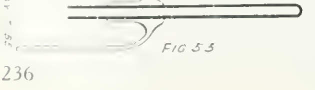

FIG 53

The Cathode

56. To obtain x-rays for good radiographs, as already noted, cathode rays must be focused at a small region on the face of the target. The focusing is done partly by the curved shape of the cathode, partly also because the walls of the glass and the layers of air adjacent to the electrode become negatively charged and exert a repulsive force on the negative rays. This force repels the cathode rays to the centre of the target, so that even with a plane cathode, a certain amount of focusing takes place. To some extent also the nature of the focusing depends on the gas pressure. Here it may be noted that it is not desirable to have the high tension transformer too near the tube, because the effect of the strong magnetic field on the cathode beam may be injurious to proper focusing.

The choice of the metal used for the cathode depends largely on the degree to which sputtering exists. Experiment has shown that tungsten, tantalum, and aluminum in comparison with metals such as platinum, silver, lead, sputter remarkably little. Aluminum, therefore, which is so readily obtained, is invariably used as the cathode. (To prevent sputtering from the wires connecting the cathode with the external electrode, these wires are sometimes encased in glass tubing).

The Anticathode

57. We have seen in the preceding chapter that a beam of cathode rays represents a considerable amount of energy. At the focal spot, where this energy is concentrated, enough heat may be developed to melt and so puncture the target. But, even if the face of the target is not punctured, the metal may be heated to such a degree that it easily vaporizes, and subsequently is deposited on the walls of the tube. Evidently it is desirable (1) to choose a metal for the target which has a high melting point; (2) to keep the target as cool as possible.

In Table V will be found numerical data relating to certain metals which are of interest to the x-ray worker.

It will be seen that platinum, which for several years was the metal used to the greatest extent as anticathode, is by no means the most satisfactory. Compare it with tungsten, for example. Its melting point, 1750°C., is little more than half that of tungsten, 3300°C. Moreover, platinum is one of the metals which sputters readily, whereas tungsten sputters but little. For this reason, should any inverse be present in the case of a platinum target tube, blackening would soon be pronounced. (During inverse the anticathode will act as cathode). In recent years, therefore, tungsten has been gradually replacing platinum, partly, perhaps largely, because of the research work of the General Electric Company, Schenectady, on the production of wrought tungsten.

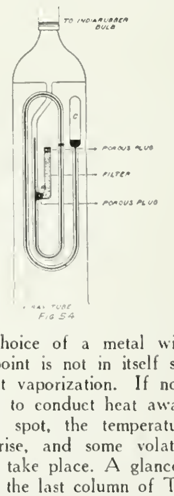

FIG 54

The choice of a metal with high melting point is not in itself sufficient to prevent vaporization. If no means are taken to conduct heat away from the focal spot, the temperature will steadily rise, and some volatilization will soon take place. A glance at the figures in the last column of Table V will show that evaporation of a metal may take place at temperatures considerably below the melting point. In a good anticathode, therefore, some means is used to prevent the temperaure from rising quickly. This is done to some extent by using a heavy piece of metal as connecting link between the target and the external electrode of the anticathode. Copper, because of its high thermal conductivity, as well as its low specific heat is a suitable metal. Addi-

tional cooling is sometimes provided by attaching to the end of the anticathode outside the tube, thin sheets of metal which act as radiators of heat. (A good example of this is found in the radiator type of Coolidge tube, to be discussed in the next chapter).

Another means is found in the use of water cooled targets. In this case (see Fig. 55) the hollow anticathode is filled with water, which accordingly is directly in contact with the back of the target. Because of convection currents set up in the water or because of an actual flow of water, the temperature of the target may be kept below even 100°C., and practically all the evil effects of hot targets eliminated.

Output of X-Rays

58. Another important reason for using metals of high melting point is found in the fact that such metals are usually also of high atomic weight. Now, other conditions being the same, the intensity of a beam of x-rays emitted by a tube increases with the atomic weight, or, putting it in another way, is proportional to the atomic number (see Sec. 42). In this respect there is not much to choose between platinum, irridium, osmium, tungsten and tantalum, but any of these is markedly superior to nickel, for example.

Regarding this whole question of output, we may note one or two further points. If we look on an x-ray tube as a "machine" for the generation of what we call x-rays, it is remarkably inefficient. Only an extremely small fraction of the total electric energy supplied a tube is changed into the energy represented by the x-rays themselves. The intensity of the beam, however, is at least roughly *proportional* to the energy supplied the tube per second, or as noted in Section 21, to the product volts x milliamperes. By steadily increasing this product, the intensity of the x-ray beam steadily increases. There is, however, a limit to the energy (volts x milliamperes x time) which may be supplied a tube. This limit depends largely on the rate at which the temperature of the cathode rises. With a "fine focus" tube, for example, that is, in the case of one in which the cathode beam is focused to a small area, less energy can be supplied than with a broader focus tube. In the latter case, the intense heat generated at the focal spot is spread over a larger area. Again, the larger the tube, in general, the greater the amount of energy which may with safety be supplied it.

To sum up, every tube has a maximum allowable input of energy and an operator should always be extremely careful not to exceed this maximum. It would be a wise precaution if on every tube, this value were plainly marked. This would at least help to prevent the ruining of a tube which sometimes occurs at the very outset of its career.

The Auxiliary Anode

59. In almost all gas tubes, the anticathode is in electrical connection with an auxiliary anode (N, Fig. 49). Such an additional electrode is not necessary, and, to quote from Kaye's admirable book on x-rays, its "precise benefit is doubtful." Two or three points in connection with it, however, may be noted. A discharge passes with difficulty through a vacuum tube when the anode is within the dark space (see Sec. 44). Now, in the case of an x-ray tube, as we have already seen, exhaustion is continued until the dark space fills the whole body of the tube. If, therefore, no auxiliary anode were present, since the target is in the center of the tube, the discharge would pass with greater difficulty. Again we have seen that the old type of valve tube (Sec. 38) acts as a rectifier, because the less restricted electrode in a tube functions more readily as cathode. Accordingly, without the auxiliary anode, the anticathode (being less restricted), would tend to act as cathode and actually help to suppress current in the right direction. Finally, should inverse current be present, there is an advantage in having an auxiliary anode made of aluminum, which, as already noted, sputters an exceptionally small amount.

Danger of Inverse

60. In section 48 it was pointed out that when the tube current is in the right direction, the whole half of the bulb in front of the plane MFM (Fig. 49) is fluorescent and separated from the other half by a sharp line of demarcation. When the current is in the wrong direction, there is no such sharp line and the central portion of the tube is not divided into two well-defined halves. In this case, the glass in the region of the cathode exhibits fluorescence in a somewhat irregular fashion that may vary with the particular tube used. This fluorescence is the result of the impact on the walls of the tube of cathode rays sent from the target (the cathode during inverse) and may be looked on as a danger signal. It means that there will be an excess of heat developed at the regions where the fluorescence exists, with consequent possibility of a tube puncture. The x-ray switch should at once be opened or the loss of a tube may be the penalty.

The Residual Gas

61. In Section 50 reference has been made to a tube in which, because the residual gas is hydrogen, it is possible either to raise or to lower the vacuum by means of palladium tubes. Obviously in this tube, the residual gas must be hydrogen. In the same section, however, it was stated that the gases liberated from the ordinary vacuum regulators, are carbin dioxide and water vapour. Which gas, therefore, if any, is the most suitable? Is there any decided advantage in one over all the others? Consider, first, the question of constancy of vacuum. We have seen that, because of the adsorption of the residual gas by the walls of the tube, as well as by metal surfaces inside it, there is always a progressive hardening.

TABLE V.

Metal	Atomic Weight	Atomic Number	Melting Point	Thermal Conductivity	Specific Heat	Volatilization detectable at
Platinum	195.2	78	1750°C	0.17	.03	1200°C
Iridium	193.1	77	2290°C	0.17	.03	1400°C
Osmium	190.9	76	2700°C	0.17	.03	2300°C
Tungsten	184	74	3300°C	0.35	.03	1800°C
Tantalum	181.5	73	2900°C	0.12	.04	......
Molybdenum	96	42	2500°C	....	.07	......
Copper	63.6	29	1084°C	0.92	.09	......
Nickel	58.7	28	1450°C	0.14	.10	......

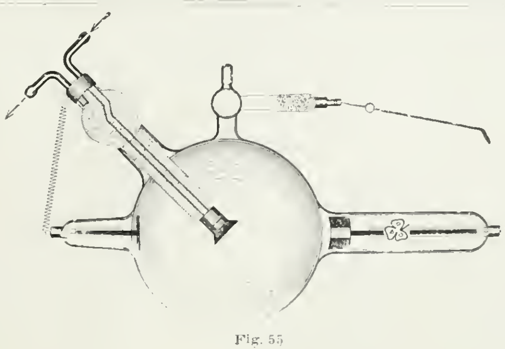

Fig. 55

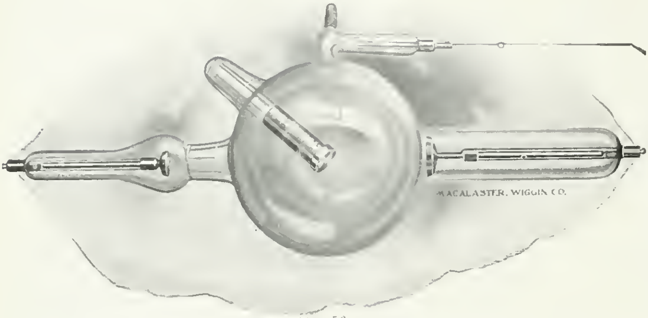

Fig. 56

Is this phenomenon more marked with some gases than others? A partial answer to that question is found in the research work of the General Electrical Company, of Schenectady, and in that of Mutscheller, of the Wappler Electric Company. The former work has shown that all gases are adsorbed by the glass walls of a tube, while oxygen and nitrogen combine with hot tungsten. The experiments of Mutscheller have shown that with the metals copper, iron and aluminum there is less absorption of nitrogen than of oxygen and hydrogen. He concludes, therefore, that nitrogen is the most suitable residual gas, and because of such experiments has designed the nitrogen tube with the vacuum regulator already described. In this tube, it will be recalled, the gas released by the regulating substance is nitrogen.

Again, according to Kaye, bulbs originally filled with hydrogen, nitrogen, and carbon dioxide show less sputtering than is the case with air and presumably oxygen. Moreover, volatilization is much less marked in the case of platinum, rhodium and iridium when oxygen is absent from the surrounding gas. For these reasons, therefore, it does not seem desirable to use air as the residual gas because of the large percentage of oxygen present. On the other hand, to quote Kaye once more, "for the same pressure a tube runs harder in hydrogen and still harder in carbon dioxide than in air" and "a tube rendered unsteady by the hardening effect of hydrogen may often be caused to run smoothly by letting in a little air."

To sum up, there does not seem to be overwhelming evidence in favor of the marked superiority of one gas over another, although something is to be said for nitrogen. Possibly the extent to which the Coolidge tube is replacing the gas tube is at least partly responsible for the lack of conclusive evidence on this point.

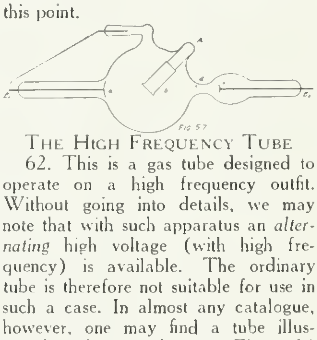

Fig 57

THE HIGH FREQUENCY TUBE

62. This is a gas tube designed to operate on a high frequency outfit. Without going into details, we may note that with such apparatus an *alternating* high voltage (with high frequency) is available. The ordinary tube is therefore not suitable for use in such a case. In almost any catalogue, however, one may find a tube illustrated of the type shown in Figure 56 and Figure 57. This tube differs in two respects from the ordinary gas bulb; (1) the anticathode (A) has no external connection; (2) the end (c) of the electrode which functions as the anode is behind a constriction (d). Now the question to be explained is this. When an alternating high voltage is applied directly to the terminals E_1 and E_2, why does current pass only when E_1 is the cathode? The reason is given in the words of Mr. C. N. Moore, of the Research Laboratory, General Electric Company, "During the half-wave when *a* is negative, the cathode stream from *a* impinges upon *b* producing x-rays, and the charge leaks off through the gas to c. When *c* is negative, there is no cathode stream from c because the constriction at *d* prevents bombardment of it by positive ions and the escape of electrons from the small side bulb. Thus, no current passes through the tube during this half-wave." In other words, this type of tube is its own rectifier.

63. In conclusion, it should be evident that, in buying a gas tube, the exact kind of apparatus with which it is to be used should always be stated. A high frequency tube, for example, is not meant for use with a transformer outfit. Moreover, even a tube most suitably chosen is liable to exhibit certain idiosyncrasies. The intelligent operation of any kind of tube is possible only by one who understands something of the nature of the passage of electricity through a gas. In the last two chapters of this course, the writer has tried to present the necessary fundamental principles of this branch of electricity. It would not be fitting if he concluded them without expressing his indebtedness to the authoritative book to which reference has already been made more than once, Major G. W. Kaye's *X-Rays*.

FOOTNOTES.

1—Later we shall see that the terms "hard" and "soft" are also applied to describe the character of the rays leaving a tube.

2—Levy and Mann: Am. J. Roentgenol. 8:112, March, 1921.

3—American J. Roentgenol. 7:261, May, 1920.

The Present Status of Radiation Therapy-With Case Reports*

J. THOMPSON STEVENS, M. D.
Montclair, N. J.

DURING the year of 1921 a great surgeon whom we all respect, Dr. John B. Deaver, is reported to have said, "Nothing can be looked for from radium in the treatment of cancer." Surgeons of equal prominence, and most physicians, agree that radiation therapy properly done is of great value in the management of malignancy. In this paper I shall try to search out the causes for Dr. Deaver's statement, and shall set forth as clearly as possible the necessary qualifications for proper radiation therapy.

I do not believe that we as radiotherapists can satisfactorily dismiss the questions that have been raised by saying, "That is from a surgical source."

Radium, properly used, is one of our very best agents in combating malignancy, but we must not depend upon it alone in all cases, nor must we expect it to do the impossible. It is to be regretted that radium is so easily applied. Men all over the country whose chief interest is in surgery or in some other branch of medicine are buying and using radium; they are as I have heard it stated, "getting into the radium game." It is next to impossible for any one to keep thoroughly up to date in both radiation therapy and surgery, or in any other branch of medicine. Present day radiotherapeutic methods have entered the stage of an exact science and any one of us who tries to keep thoroughly up to date will find little time for anything else. I am satisfied that if I, with little or no training, were suddenly to take up surgery that there would be immediate cause for criticism and I ask you whether under such circumstances surgery or I should be criticised?

When, using the correct dosage, we place radium within or upon a malignant growth we can expect a destruction of malignant cells within a radius of three centimeters only. This proven statement, it seems to me, indicates the reason for failures with radium alone. Beyond this radius of three centimeters any malignant cell struck by these radium rays will not be retarded or killed, much the same as removal of part of a malignant growth by means of the knife will not kill the malignancy. At the end of such treatment our patient is generally worse than before. Some of the malignant cells have received a partial dose of radium rays and have become more "adult in type," i. e., they become at least partially ray fast and further radiation does no good.

Some workers are using radium at great focal distances from the surface of the body so as to radiate the growth and its lymphatics, hoping that this with perhaps internal radiation in the form of needles placed directy into the growth will produce the desired results. Dr. Russell Boggs has said that it takes about 92 grams of radium to equal the radiation coming from a roentgen bulb working under proper treatment factors. With any such amounts of radium as any one in the world has, external radiation with radium in malignancy will be done only at tremendous time and expense and with generally unsatisfactory results. One exception to this rule is found in the treatment of metastatic nodules in the axilla following amputation of the breast, when the scar extends onto the arm in such a way as to prevent its being raised enough to allow the roentgen rays to be sent directly into the axilla. In such a case it is justifiable to use a radium pack in the axilla but better than this is to crossfire toward the axilla from every possible angle with the roentgen rays, and then to place radium needles directly into the nodules. Radium, however, is easy to use, we do not have to watch it constantly—all we have to do is to remember when to remove it from the patient's body.

It is my belief that our results in cancer will depend more upon our skill in using the roentgen rays, for here we have an unlimited supply of radiation, than it will depend upon the fact that we have one or more x-ray machines and large quantities of radium. With radium at its present price and limited production I believe that any improved results obtained from time to time will be the results of increased knowledge of the roentgen rays. Leaders in our work, Drs. Pfahler, Boggs, Schmitz, Tyler, etc., are not using radium alone in any case of malignancy except perhaps an occasional epithelioma. In my own laboratory radium is never used until after one full series of roentgen radiations have been completed. Almost daily, I believe, I see the value of this plan. I do not mean that I cure every patient who presents himself to me with cancer, but I do mean that the satisfactory results obtained by me are in the majority rather than in the minority. Many of the cases are past the stage where other methods can be looked to for help, and the results obtained in the majority of them clearly indicate that radiation therapy is of tremendous value in the management of malignancy. Satisfactory results will mean permanent cure in some cases, only palliation in others. So far as I know there is no physician, except the Great Physician, who has the power to cure every case of any disease that comes to his door.

Proper use of the roentgen rays does not consist in simply letting the rays play upon a certain part of the body until the alarm clock rings or until the door bell announces the arrival of another patient. When a patient is to have roentgen treatment he must be measured in every direction that the location of the disease will permit. The location of the growth, its depth from all surfaces, etc., must be known. A patient with one set of measurements cannot have the same treatment as another patient who has entirely different measurements, or one who has the disease in an entirely different part of his body. After measurements are completed, if the apparatus to be used has had its output and intensity in the various depths standardized, we can figure out on paper just how many doses or areas with certain treatment factors are necessary in order to deliver a "cancer dose." Then we are ready to start our treatments. We must watch the apparatus and patient constantly and we must expect expensive breakdowns at times. The entire roentgen technique is tedious and time consuming, we cannot practice surgery or some other branch of medicine and do roentgen therapy properly. I am sure that radium is so frequently used alone because roentgen therapy takes time and training which the busy physician cannot afford to give it. In my own case I have learned that even roentgen diagnosis and treatment cannot be mixed with entire satisfaction, unless one can have two separate staffs, one for therapy and one for diagnosis.

I have mentioned the fact that in my laboratory I never use radium locally until at least one full series of roentgen radiations has been completed. The point I wish to make especially is this, that almost to a man we are advising preoperative radiation. In my opinion preradium radiation is at least equally important. I am sure that the surrounding lymphatics and the primary focus

*—Read at the Midyear Meeting of the Radiological Society of North America, St. Louis, May 20, 1922.

of the disease itself are more in need of preparation by means of the roentgen rays preceding destruction by radium than preceding removal by surgery.

The surgical side of malignancy is of tremendous importance. No case of operable malignancy should escape operation and any case of inoperable malignancy that becomes operable under radiation therapy should likewise be operated. Even in operable cases, however, both preoperative and postoperative radiation therapy should be used. The preoperative treatments are of most importance because many of the cells are killed or destroyed, the lymphatics draining the area are more or less obliterated, thus tending to prevent metastasis; any transplanted malignant cell that is properly rayed will not produce a metastatic malignancy.

Electrothermic coagulation is a method of treating certain forms of new growths occurring in certain localities. Until recently it has not been very popular with many of us but lately it is justly becoming more popular. When possible it is good practice after preliminary roentgen radiation to remove local manifestations of disease by means of electrocoagulation. It has several advantages over any other method. At no time during the operation are the lymphatics or the blood vessels opened, for the same current that coagulates or destroys the other tissues seals the lymphatics and blood vessels. Because of the former action there is less chance for metastasis, and because of the latter the operation is bloodless. During the operation of electrocoagulation we must make sure that we destroy all the disease, i. e., we must see that coagulation extends well out into the healthy tissue; it should in fact begin in the healthy tissue, the diseased tissue being destroyed last. When coagulation is completed we may remove the diseased tissues by cutting them away, always keeping well within the coagulated area, or we may allow the whole mass to slough away itself. Electrocoagulation is one of the most efficient methods, if not the most efficient one, known today for removal of malignant tissue without subsequent recurrence or metastasis or both. This method is not particularly known for its power for beauty but in cancer we are dealing with questions of life and death. It is unfortunate that all localities affected by malignancy cannot be treated by this method. However, one is at once struck by a surprisingly good cosmetic result following so much destruction.

Electrocoagulation can be used to advantage in cancer of the bladder (suprapubic cystotomy), leukoplakia, cancer of the tongue, malignant tonsils and other oral pathology. Lately I have used the method for malignant tumor within the sigmoid colon, and for cancer of the cervix, etc. I believe it is the best method of treatment for malignant dermatitis caused by radium or roentgen rays. In this latter group of cases it is of course not preceded or followed by radiation.

In the above paper I have tried to show that radiation therapy should not be criticised until it is known just how the physical agents were used in a certain group of cases. If due consideration is given to the technique used, very often it will be found that the technique is at fault rather than the roentgen or radium rays. I know that a leading radiotherapist has in the past and still is obtaining generally entirely satisfactory results in Dr. Deaver's cases. Some of these results are miraculous and in nearly every case they are palliative to a degree such as can be obtained by no other means, opium not excepted. I know that Dr. Deaver is not criticising the results obtained by this operator.

Conclusions.

1. The largest group of cases that can be cured are the operable cases. These cases should be operated about two weeks after thorough roentgen treatment. Then postoperative radiation should be given.

2. The borderline cases, i. e., those that are just beginning to show evidence of metastasis, should be treated by radiation therapy, both the roentgen and radium rays being used. Should they become operable they should not be denied the advantage of operation. Some of these should result in cure and palliation will result in all.

3. Definitely inoperable cases should be treated with radiation therapy only, except the very few that become operable. The results with this group will not equal those of group two.

4. Hopeless cases should have the benefit of radiation therapy that they may discontinue the use of opium and that they may die a painless death.

5. Radium should not be used alone in any case of malignancy but should always be preceded and followed by the roentgen rays.

6. When judging radiotherapy, physicians and surgeons should always remember that many of the cases referred to the radiotherapist are those which have progressed so far that recovery through any method or combination of methods of treatment is impossible.

7. More cases in any group will be cured if combined methods of treat ment are used whenever indicated.

Case Reports.

Case No. 1. Mr. J. K. Age 82 years. Patient of Dr. T. Paczkowski. Nine years ago following a cut upon the lower left lip by a barber an ulcer appeared at the site of the cut and was treated by surgical removal, by carbon dioxide snow, and by several applications of the actual cautery. At the time patient reported to me there was great pain in the lower left jaw extending up to the left eye and downward to the left clavicle. There was a large mass just to the left of the chin outside the cheek, also one inside firmly adherent to the jaw bone. There was a metastatic nodule in the middle of the lower lip, also many extending downward to the left clavicle. Roentgenograms of the lower left jaw bone showed extensive involvement of the bone in its anterior half. The last incision into the growth had never healed and was a discharging ulcerating fissure.

Treatment was started with the roentgen ray September 5, 1921, at which time the entire neck and face were covered, always centering the rays to the disease. Radium was then planted throughout the mass and metastatic nodules. This treatment, followed by two more series of roentgen rays and treatment was completed November 17, 1921.

Result: There has been no pain since the first roentgen series was completed and the metastatic nodules have disappeared. There is now a firm hard mass of contracting fibrous tissue at site of the primary growth, which has pulled the mouth toward the left. The nodule inside the cheek has disappeared. Roentgenograms of the jaw show that the bone has healed except at one point near the symphysis which gives a typical picture of necrosis. January 3, 1922, the patient was referred to Dr. W. E. Doremus for a plastic operation and care of the necrotic area.

Case No. 2. Mrs. A. B. M. Age 71 years. A patient of Dr. A. B. Twitchell.

Late in July, 1921, a lump appeared at about the middle of the thorax just to the left of the spine. It had been growing rather rapidly just previous to the time the patient was referred to me and the pain was so intense that the patient could not sit while the history was being taken. The growth appeared to be as large as a duck's egg. Roentgen examination by Dr. Charles F. Baker showed, just to the left of the mid-dorsal spine, a growth which had already pushed the spine considerably to the left. Dr. Baker's diagnosis was probable sarcoma arising from the mediastinum.

October 7, 1921, treatment was started. The pain was so great that it was impossible to arrange the patient upon the table and it became necessary to resort to narcosis. Treatment consisted of roentgen rays alone.

Result: One month after treatment patient reported that there had been no pain for two weeks. The external evidence and likewise the roentgen evidence of the growth had disappeared. The spine was straight. This patient was seen one week ago and is still free from pain with no recurrence or metastasis, and she is very happy.

Case No. 3. Mr. H. A. Age 58 years. Patient of Drs. W. E. Doremus and A. A. Mutter.

Present trouble began about two years ago with a somewhat acute attack of absolute constipation which lasted three days. Then followed a year of gradually increasing difficulty at stool. One year after the first attack of absolute constipation another like attack occurred and although the patient eventually secured partial relief the difficulty at stool continued to increase, stools contained blood, and there was general malaise. June 13, 1921, there was another attack of intestinal obstruction which resisted all treatment.

Abdominal section by Dr. W. E. Doremus showed an inoperable mass in the pelvis springing from the sigmoid. A colostomy was done and radiation therapy was advised. Roentgen rays were delivered to the pelvis. The entire pelvis was covered, front, back, and both sides.

One month following the radiation treatment bowels were moving by both colostomy bag and rectum, and upon sigmoidoscopic examination, I found that the instrument passed easily into the sigmoid, whereas in the beginning I had been unable to get the instrument past the rectum. I believed that the case was now operable, which opinion Dr. Doremus confirmed.

At a second abdominal section Dr. Doremus found that the growth was operable. It was removed and the microscope showed it to be adenocarcinoma. Then an end-to-side anastamosis was done and the colostomy closed. This was followed by a series of postoperative roentgen ray treatments.

Result: To date (May 3, 1923) this man is well in every sense of the word. His bowels move daily, without medication, in an entirely normal manner. There is no sign of recurrence or metastasis anywhere. He has regained all the weight lost during his illness and is still steadily putting on additional weight. I am satisfied that Dr. Doremus feels that this result could not have been obtained by any known surgical method of treatment alone. I am equally sure that this result could not have been obtained in so short a time or with so satisfactory results with any known radiotherapeutic method alone. To me this case seems to show distinctly the value of combined methods in the management of malignancy and especially the value of preoperative radiation.

With this case I wish to report eight other cases of inoperable cancer of the rectum and lowermost portions of the sigmoid which I have treated by combined methods of radiation therapy and electrocoagulation. These eight cases are all discharged. All are free from general systemic symptoms of cancer, but at the site of the former disease in each there is, of course, a mass of fibrous tissue, which, due to the normal contraction of scar tissue, has naturally caused varying degrees of deformity of the parts involved, with more or less obstruction. Perhaps some of the cases will require colostomy for obstruction in the future, others may develop metastasis or recurrence; but the fact remains that they are now alive, while I am sure that every one of them would have died long ago, had they been treated by any other method with which I am acquainted. These cases, with one exception, were all started and finished prior to December 31, 1921. Since January 1, 1922, four more cases have been treated by the same method; one died of pneumonia before leaving the hospital, one died an operative death and the other two are too recent for any conclusions to be drawn.

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EDITORIAL

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Rochester, Minnesota
December 3, 4, 5, 6 and 7, 1923

Professionalism or Commercialism?

"Well, do you believe that anything I have written will survive me?"

These, the last recorded words of Alexandre Dumas, express the sentiment which is deep in every man's heart. The question which really concerns the man, whether he is the artist, the author, the scientist or the physician, is whether his accomplishments will really survive his demise. The great Dumas succeeded in erecting a perpetual monument to himself by his world read novels. More than 80,000,000 copies of his works have been sold in France alone, beside the countless numbers translated into every language. Today the fascination of the Three Musketeers is just as gripping as when fresh from the author's pen. Today Alexandre Dumas remains "the most fascinating writer and the most popular novelist, not only of France, but of the whole world." A great surgeon expressed himself to Alexandre Duma's son in the following glowing tribute to the father: "All our hospital patients recover or die with one of your father's books under their pillow. When we wish to make them forget the terror of an approaching operation, the tediousness of convalescence or the dread of death, we prescribe one of your father's novels and they are able to forget."

Inquiry into the cause of the remarkable success of the life of Alexandre Dumas may prove interesting. His son paid a great tribute when he said: "Man will never take a lasting pleasure in the history of his turpitude and baseness. * * * but he will soon sicken of such pictures and he will always return to what is healthy and cheering. Whenever his mind and heart are appealed to he requires a hope, a consolation, a support and an ideal." Corot said: "Art is not art, unless it makes man merry."

Alexandre Dumas fulfilled all of these requirements, furnishing not only an ideal for all who read, but at the same time giving them great pleasure.

The citation of this valuable and illustrious example in the literary world is not without its value to the medical profession under the present apparent unrest. There seems to be a spiritual unrest among the members of the medical profession, due to the changing economic situation in the United States and elsewhere. There seems to be a struggle to decide between commercialism in its baldest form on the one hand and the pursuit of an ideal on the other hand.

The commercial element in those practising the healing art in the United States is well represented by the money grabbing, advertising methods of the chiropractors and of those who employ the deceitful methods of Abrams. These methods put money in the pocket of the man employing them, but at the same time rob him of an ideal and the patient of a genuine service. Some excuse their methods by saying it is simply good salesmanship. We feel that time will prove that this type of salesmanship in medicine will act like a boomerang just as it has in the business world. The Association of Advertising Clubs has been promoting truth in advertising for a number of years and has induced many newspapers to accept only truthful advertisements. As a result of the adoption of this standard many advertisements of a medical nature are refused space in some of the leading publications. Among those refused are the questionable ones just mentioned.

Professor Gardner of the University of Wisconsin, Department of Commerce, recently advocated a campaign of education carried on by the medical profession as a whole. This material could be prepared by a layman publicist employed by the medical profession, all of his copy being submitted for approval before being published. The purpose of this publicity would be to let laymen know what the ideals and purposes of the medical profession are and to inform them what the profession is able to accomplish in the treatment of the various diseases affecting mankind. Professor Gardner stressed the point that in all this publicity the public would be more apt to read pleasing articles which tell of the hopefulness of serious conditions and the meritorious achievements of the makers of medical history.

A commercial man recently put the problem a little more concretely than did Professor Gardner when he said: "The thing the medical profession as individuals lack is positiveness. The sick man comes to his physician for help and he wants the physician to not only give him the help, but to assure his mind that the course of treatment outlined will give the desired help." It would appear that this man has made a keen analysis of the psychology of the sick individual. The same principles apply here as elsewhere in the realm of salesmanship. This plan, coupled with truthfulness, will solve the economic difficulties of the medical profession.

Unselfish devotion to the ideal of service to humanity will win. Service above self is a practical motto as well as an ideal one. Professor Herman von Schulte, Dean of Creighton Medical College, recently said, "It would appear that truthful service rendered by the physician will naturally bring its financial reward."

A Portion of an Address on Publicity*

The medical profession holds the welfare of society in its hands. It has made almost incredible strides and it is rendering a monumental service, a service which touches us all deeply and personally. The control of typhoid fever, of yellow fever, of tuberculosis, all these are achievements which offer proof of the assertion just made. This truth is well known to each of us here, but the public at large does not realize the truth about medicine any more than it realizes the truth about economics, politics, science or religion.

Following the war, when we saw civilization swept away with a ruthless hand, there came to us a sense of exhaustion and of futility. When I saw men mown down by the hundreds of thousands it affected me so deeply that I

did not care whether I lived or died. It would have been an easy matter for me to have ended the whole thing then, but I came back to sanity and to the realization that in dealing with human nature we are dealing with the stuff that makes anything possible. We know that some people will never amount to anything, but it is impossible to foretell which these ones will be. I do not despair of education, and in my position I know what college men and women are.

Following the war came also the realization of how great is the ignorance of the world and a knowledge of how deeply affected it has been by the old inhibitions, and so today we are experiencing an awakening, manifested everywhere by a seeking after knowledge, a seeking after a new heaven and a new earth in all things, in things as divergent as politics and medical science. The battle waged by Tyndall and by Huxley is not yet won when it is possible for Mr. Bryan to arouse legislators to a point where they are almost ready to prohibit the teaching of biological sciences in our schools. We are threatened today, gentlemen, and as leaders of society we have a responsibility resting upon us. I sincerely believe that it is the duty of the medical profession to bring about, by whatever means possible, a fuller knowledge of the truth.

I think that the premises upon which I base my belief are sound. We will not disagree, I think, that we know more than we used to know, that the new discoveries of psychologists and biologists have yielded results.

I have not made an extensive study of this, but I believe it is true that at the time Huxley delivered his lectures it was quite possible for him to collect a representative audience and to make a speech and have it reproduced, I do not know in just what form, whether in book form, pamphlet form or magazine form, but I do know that he reached a few representative audiences in Great Britain and that though the reading public was smaller than it is today, public opinion could be formed and leadership created by use of the lecture, and perhaps pamphlets, more easily than is possible today, when everybody reads the newspapers at least.

To illustrate what I mean let me say that at our university we have found Freshmen who literally and absolutely have never read any book outside of the books read in school. Their families owned no books, they had never bought a book, never borrowed a book, had never read even a novel. It may seem incredible. I do not think it is a widespread situation, but such people do exist. They do not read books, but they read magazines and newspapers.

This lends force to the statement that if you reach the public of today you must make use of the media which the public uses. The utterances of only our most prominent men, such as Hoover, Harding, Wilson, are reproduced in the newspapers because the newspapers know that the public does not care for much of this type of reading. Editors are blasé and cynical, they think that they know what the public wants and they give it to them. Great orators and publicists know how to appeal to and to form public opinion, but the professional man rarely knows how to appeal to the public, it is an art by itself. A doctor says to a newspaper man, "Publish this," but usually it looks pretty dry to the newspaper man, he thinks the public will not read it and he says so.

I have no easy formula to present, but I do believe that if Huxley and Tyndall were here again that they would use whatever implement they found at hand to make the truth prevail. I think my reaction when it comes to doctors advertising is about the same as is yours. I have a feeling not based solely upon traditional ethics, but upon another feeling, and I would say do not advertise in this way. I could not stultify myself and my friends by advertising in the blatant, vulgar, disgusting way of the chiropractors, and whatever publicity medical men undertake should not welter in gore. The layman is not a scientist and he cannot look unmoved upon pictures of cancer, etc. I have in mind a medical journal that wanted to advertise medical truths and started off with pictures of cretins and other horrors. Lately I heard a lecture by the great rebuilder of war-wrecked faces, and I saw the slides illustrating this lecture, and although I was glad to learn these things, it made the entrails curl up inside of me. The layman will only turn and run in the other direction when presented with this sort of thing. In contact with your patients you take infinite pains not to offend their sensibilities, not to terrify them, but to guide them safely through the vale of terrors in which they find themselves, they lean on your arm and you shield them from these terrors and from that worst terror, the imagination. The public mind will have to be considered if you want to undertake publicity.

You are scientists, you are assailed by quacks, the public is assailed by quacks. How they may affect your pocketbook does not concern me, but my welfare and that of my wife and boy does concern me, and I do not want them treated by a quack while you sit silently by, unable to utter a word. You need not advertise like a chiropractor, like the manufacturer of shredded what, or of soap or of face cream. Your advertising must be dignified and unique. It is a thing that can be done, it is simply an application of brains to the problem. I wish that I knew how to make what I have to say more forceful. I believe in education and in the responsibility of the educated mind to lead public opinion. An article in the Saturday Evening Post scores the average citizen because he does not take a part in politics, but lets others lead. What shall be said of the medical man if he hides his light under a bushel?

If you are imbued with the truth and want to make it prevail, then in Heaven's name seek out a way. I believe if the best brains were given the problem they would find the way, because of the magnitude of it.. It is a marvelous thing, a thing that cannot be surpassed in advertising, it never could be, for there is nothing which surpasses in greatness the struggles that medical men have so willingly gone through with for the sake of humanity. It can be done. It's up to you.

*—Presented before the Omaha-Douglas County Medical Society at the University Club, May 1, 1923, by Prof. Edward Gardner, Department of Commerce, University of Wisconsin.

Recognition Abroad

Dr. Arial W. George, of Boston, was honored by being chosen to deliver the annual Sir James MacKenzie Davidson Lecture, which he did at London, May 17th, before a joint meeting of the Roentgen Society of London and the Electrotherapeutic Section of the Royal Society of Medicine. "The Pathological Gall-Bladder" was the subject of his lecture.

Dr. George is the first American to receive the Sir James MacKenzie Davidson Medal, a tribute of which he and his countrymen may well be proud.

South Dakota Radiological and Physiotherapy Society

At a meeting held May 21st, 1923, at Watertown, S. D., the South Dakota Radiological and Physiotherapy Society was organized with the following officers:

President. . . . . .N. J. Nessa, M.D., Sioux Falls
Vice-President. . . . . .F. Koren, M.D., Watertown
Secretary-Treasurer. . . . . W. D. Alway, M.D., Aberdeen

Nebraska State Radiological Society

The following officers were elected at the meeting of this society, held at Lincoln, May 14th, 1923:

President . . . . R. L. Smith, M.D., Lincoln
Vice-President . . . . R. C. Woodruff, M.D., Grand Island
Secretary-Treasurer . . . . R. W. Fouts, M.D., Omaha

Western Electrotherapeutic Association

The fifth annual meeting of this association was held, under the presidency of Dr. T. Howard Plank, at the Little Theatre, Kansas City, Missouri, April 19 and 20, 1923.

Preceding the meeting the Western School of Electrotherapy, held a three days' session, with a class of one hundred.

The following officers were elected for the coming year:

President . . . . H. H. Bowing, M.D., Rochester, Minn.
First Vice-Pres. . . E. H. Skinner, M. D., Kansas City, Mo.
Second V.-Pres., A, David Wilmoth, M.D., Louisville, Ky.
Treasurer . . . . . . W. P. Grimes, M.D., Kansas City, Mo.
Registrar . . . . B. C. Harris, M.D., Sapulpa, Okla.
Board of Trustees . . T. Howard Plank, M.D., Chicago, Ill.
. . . . . . B. B. Grover, M.D., Colorado Springs, Colo.
Secretary . . . . . Charles Wood Fassett, M.D., Kansas City

Next meeting will be held in Kansas City, April, 1924.

CHARLES WOOD FASSETT, M.D., *Secretary.*

DEPARTMENT of TECHNIQUE

Practical Problems in the Administration of High Voltage X-Ray

ROBERT H. MILLWEE, M. D.
Dallas, Texas

AT THE Chicago meeting a year ago it was my pleasure to talk to you briefly regarding a new type of x-ray installation in which the tube was enclosed in a booth. I am well aware of the fact that physicians and research workers have for many years employed the method of passing bundles of x-rays through a hole in the wall for experimental work, and possibly some one has used the method in treating patients before the idea originated with the writer.

The primary reason for developing this type of installation was the fear of the patients coming in contact with high tension wires, and it was only after its installation that many other good features were discovered. It will be remembered that this type of installation utilized a perpendicular wall and that a horizontal beam of x-ray passed through the opening in the wall in order to reach the patient. Many modifications of this installation have since been employed by Soiland, Ernst and various other workers.

While treating patients with this type of installation over a period of almost two years we naturally recognize its defects, as well as its many good features, and an effort has been made to eliminate, so far as possible, the imperfections. One of the more important features added is that of treating two patients from the same tube at the same time.

A careful study of the report of Dr. Coolidge on the distribution of radiation from the target of a Coolidge tube, as published in the American Journal of Roentgenology, and a study of Fig-

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, December 5th, 1922.

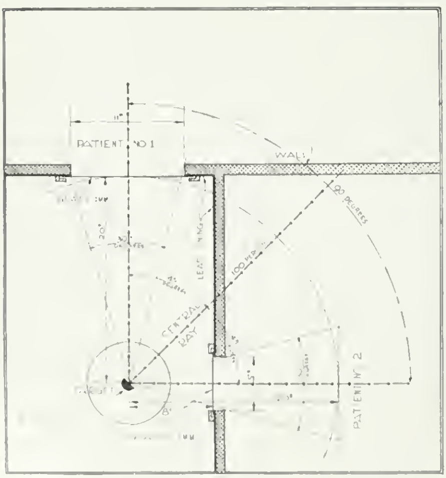

Fig. 1

Fig. 2

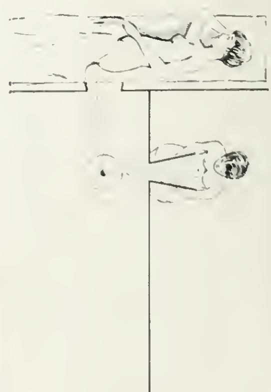

Fig. 3

ures 1, 2 and 3 will convince one that the procedure is scientific.

The writer's own installation, as used at the present time, does not have the entire transformer room lead lined, but the tube is contained in a closet 3½ by 2½ feet wide and 6 feet tall and the high tension terminals pass into this closet through insulators. The closet is lined with three-eighths inch sheet lead and a current of air is forced through it for cooling and ventilation. This is done by means of a blower situated at the floor, which takes the air by means of a pipe from the top of the transformer room in order to remove gasage from this room, and blows it directly onto the tube and passes out at the top of the booth by means of a second conduit, changing the air completely in both the tube booth and transformer room once each minute.

It will be noticed in Figure 1 that the tube is placed near one wall and quite a distance from the other wall. From wall No. 1 it is placed at a distance of 20 inches; that is, the position is such that a 20 inch skin target distance is possible if the patient is placed against the wall. This makes a desirable arrangement for treating a patient in the prone position, while at the other portal of entry it will be noticed that the tube is placed with the glass within four inches of the wall so that it is possible to secure an eight inch skin target distance, and by using a cone a twenty or twenty-five inch skin target distance is easily secured with the patient facing the tube in a sitting position, and yet the patient will have sufficient room for the knees to be comfortably situated. From this hole a patient may also be treated in the prone position. Where the glass of the tube comes within four inches of the wall we find it necessary to use glass for installation, hence 1 mm. of ordinary window glass is used over both holes, which offers about the same resistance as 1 mm. of aluminum. Clear celluloid 1 mm. in thickness is hermetically sealed over both holes in order to prevent the escape of gases and noises from the booth.

A careful study of the position of the tube in the booth as illustrated by Figure No. 1 probably conveys the idea of the arrangement more clearly than can be given in a word picture. It will be noted that the central ray is directed half way between the two portals of entry, or holes in the wall, and that the central ray passing through each hole comes from the target of the tube at an angle of 45 degrees from the central ray of the target, therefore the central rays from each portal of entry are 90 degrees from each other. It will also be noted that the ray through each portal of entry is utilized an additional 15 degrees away from the central beam of ray, so that in treating each patient, in case we should use a very large portal of entry, 11 inches in diameter, we would use a bundle of rays extending from about 20 degrees from the central ray to about 65 degrees. However, since we usually employ portals of entry of about one-half this size it is not often that we find it necessary to use this ray to a greater degree than about 52.5 degrees from the central beam.

We have made a rather careful study of the distribution of rays from the targets of six tubes and from this investigation I am convinced that the intensity of the radiation 65 degrees from the central ray of the average Coolidge tube is not materially less than that at 20 degrees from the central ray or at the central ray itself. The one factor which seems to alter the distribution of the ray from the surface of the target as reported by Dr. Coolidge, and it can readily be understood by all of us, is the character of the pitting of the target, and we can readily understand how the target may be so deeply pitted that there may be an appreciable variation in the amount of radiation over the area illustrated by Figure 1, and since the appearance of the target will not give us a very definite idea as to the alteration of this distribution of ray it is at once apparent that the mere me-

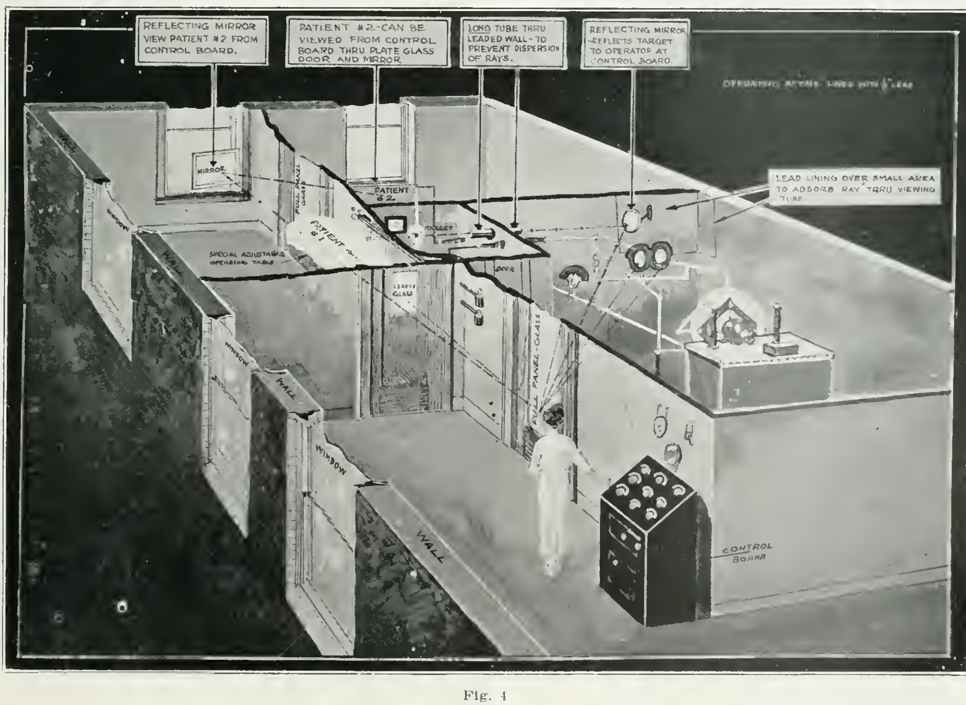

Fig. 4

chanical setting of the target for securing the radiation of two patients at one time is not a scientific process, and therefore the setting of the position of the tube must be accomplished by the aid of some method of measuring the radiation.

The author has employed the ionization process by the use of electroscopes and also the galvanometer as described by Duane, and I believe the Duane process to be most suitable for the use of roentgenologists.

A method may be adopted to treat two patients from one tube, utilizing a leaning wall. In this there is the suggestion to the patient of being under something which may fall, and it does not permit of such perfect ventilation of the treatment room nor is it so convenient for making measurements of radiation as the perpendicular wall, particularly if water phantoms are used.

Figure 4 illustrates the author's own installation and is shown particularly to indicate those important things which the operator is able to observe from one position. It may be well to call attention to the following: That from one position the operator is able to observe patient No. 1 by direct view through leaded glass in door; that she observes patient No. 2 in a mirror which reflects the image of patient No. 2 through the panel of glass in partition between the two treatment rooms; that she observes sphere gap, milliamperemeters and voltmeters, and that she observes the target of the tube by reflection and that this image of the tube passes through a long piece of pipe through the booth wall in order to prevent dispersion and scattered radiation; that both the operating and the two treatment rooms have outside windows which give sufficient light and ventilation, adding materially to the comfort and well being of patients and operator.

Fig. 5

Fig. 6

Since in using this method we shift the patient rather than the tube, we have attempted to solve the problem of shifting the patient in room No. 1 by the aid of a table in the construction of which is used a double lift dental base, or rather the base used in dental chairs, which allows the tube to come within 18 inches of the floor and has an 18 inch lift. This table is illustrated in Figures 4 and 5. The patient may be placed on the table at a height of 18 inches and then, with a long easy foot pump, raised to the proper level for treatment. Allowing the patient to be placed on the table in a low position does away with the suggestion of climbing upon something high, from which one may fall. In the case of patient No. 2 a chair resembling the ordinary dental chair is employed, which also has an 18 inch lift and a head rest. This chair and its uses are illustrated by Figures 4 and 6. Cones of various sizes and lengths are employed and the chair and table being situated on ball bearing castors are very easily manipulated, and we find it as easy to shift the patient by this arrangement as it is to shift the tube in our former method of treatment. We also find that patients generally prefer to take their treatments in a sitting position and this can usually be more easily accomplished, with a few exceptions such as pelvic conditions.

It is probably unnecessary to call attention to the great saving of time to both physician and operator, as well as the saving of wear and tear on apparatus when we treat two patients by the same facility as we formerly treated one patient.

CASE REPORTS

An Unusually Interesting Case

T. HOWARD PLANK, M. D.
Chicago

THE LITERATURE upon the subject of bone metastasis from carcinoma of the female breast is rather infrequent, and, therefore, I am presenting this report of a case which was under my constant care for nearly eight months.

The case was referred to me on January 12, 1922. For three months the patient had had considerable pain and discomfort in the right hip. Operation was delayed until after x-ray examination which showed lipping of the right transverse process of the third lumbar vertebra (Fig. 1), involvement of the ilium about the right sacro-iliac joint, also involvement of the right trochanter and upper third of the right femur as illustrated by the picture.

Physical examination at this time disclosed a hard mass involving the upper, outer quadrant of the right breast, extending into the upper inner quadrant and adherent to the integument and pectoral muscles. The axilla was filled with a similar mass of about the same size and attached to the blood vessels. There were a number of nodules in the supraclavicular space. The case was considered an inoperable one because of the extensive local metastasis and the fact that the patient had been aware of the mass for over two years.

In the following pictures you will note that the body of the vertebra has almost completely disappeared, while the disks are neary intact (Fig. 2). This is quite characteristic of malignancies in this region and is in contrast with tuberculosis of the spine, in which instance the disks as well as the body are destroyed.

With this additional data I considered the case incurable and treated it as such.

Figure 3, taken a month later, February 22nd, 1922, shows the right half of the third lumbar broken down, but with some improvement in the condition of the ilium at the sacro-iliac joint. Figure 4, taken at this time shows a pathological fracture of the right trochanter.


Fig. 1—Beginning destruction of the third lumbar.
Fig. 2—Total destruction of tenth dorsal, except disk. Showing destruction of upper and lower dorsals and lumbars.

March 22, 1922, the roentgenogram showed improvement of the third lumbar vertebra, also the beginning destruction of the tenth dorsal, left side. April 4th, 1922, roentgenograms showed improvement in the condition of the sacro-iliac joint and extension into the right trochanter.

On May 2, 1922, the picture showed the third lumbar vertebra remaining stationary, but showed a complete destruction of the tenth dorsal vertebra. On May 31st the picture (Fig. 5) showed the beginning destruction of the fourth cervical and second dorsal vertebrae with complete breaking down of the tenth dorsal vertebra.

July 6, 1922, the destruction of the third and fourth cervical vertebrae was almost complete (Fig. 6). August 4, 1922, the x-rays showed destruction of the fifth cervical and third and fourth dorsals, also renewed destruction of the third lumbar and beginning destruction of the first and fifth lumbar vertebrae. About the middle of August there was a complete breaking down of the third and twelfth dorsals.

The last picture, taken a few days before the patient died, on August 22, 1922, showed a complete breaking down of the third lumbar and further involvement of the fifth lumbar with complete involvement of the ilium, ischium and pubes. There was renewed involvement of the upper third of the

Fig. 3—Further destruction of the lumbar and illii.

Fig. 4—Destruction of both illii and right femur, upper third.

right femur and the involvement of the upper fourth of the left femur.

During this time there was no paralysis and not enough pain to require morphine.

The amount of radium used during the eight months this case was under treatment totaled 25,000 milligram hours.

The last blood count, taken ten days before death, showed:

Hemoglobin	71%
Erythrocytes	2,870,000
Leukocytes	15,800
Neutrophiles	93%
Small lymphocytes	0
Large lymphocytes	1%
Basophiles	1%

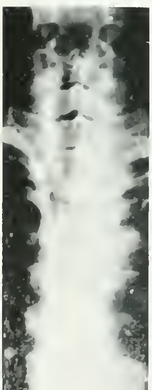

Fig. 5—Destruction of the fourth and fifth cervical, and beginning destruction of the third and fourth dorsals.
Fig. 6—Further destruction of the cervicals and dorsals.

Obstructing Foreign Body in the Esophagus Unknown to Patient

E. L. JENKINSON, M. D.
Chicago

PATIENT, a white male, 41 years of age, entered the hospital complaining of pain in the mid-sternal region, with great difficulty in swallowing. The difficulty in swallowing was not constant, as there were times when he experienced practically no feeling of fullness in the mid-sternal region and the food seemed to enter the stomach normally. During the periods of dysphagia the food was regurgitated and not even water would pass the apparent mid-sternal obstruction.

The pain was present at all times independent of food taking, and was dragging in character, accompanied by a heartburn. The emptying of the esophagus did not, to any degree, lessen the discomfort. The patient had been in excellent health up to February 25, 1923, never having experienced any difficulty in swallowing.

On February 25th, at the evening meal, the patient found it impossible to take anything by mouth. The sight of food seemed to cause him to vomit. The vomitus, however, contained none of the food eaten at the preceding meal. After several attempts to take water and coffee without success, the patient decided it was useless and attributed it to a cold which had settled in his stomach. This difficulty in swallowing continued for two weeks, during which time there were periods when the food entered the stomach with no delay. The patient seemed to anticipate times when he could swallow, and at these times would take nourishment. The dyspagia seemed to be worse in the mornings than at any other time during the day.

On March 10, 1923, the patient attempted to eat some semi-solid food. The meal consisted of potatoes and hamburger steak, which was cut into very small pieces. The first mouthful was all that was attempted, as the pain was very severe, and he thought he would strangle. The following day he came to the hospital, and was admitted under the diagnosis "Stricture of the Esophagus."

The past history is as follows:

The patient had had the ordinary diseases of childhood, measles, mumps, chicken-pox and scarlet fever. Twelve years ago he had had a primary lesion for which he had taken considerable treatment and which had been pronounced cured by his physician. Since the treatment he has enjoyed very good health.

During the winter months the patients hands break out, and a scaly, weeping eruption results, which lasts through the cold weather. During the present winter, however, he has had no eruption on his hands.

Nothing in the past history other than that mentioned above, was of any importance.

Habits

The patient uses alcohol, tobacco, tea and coffee in moderation. The appetite has always been good. Sleeps well and does not use drugs.

Family History

Father living and well at the age of 65. Mother living and well at the age of 60. The patient has six brothers and one sister all living and well. The oldest is 43 and the youngest 27.

There is no history of tuberculosis, carcinoma, nephritis, diabetes or nervous disorders in the family.

General and Negative

The patient gives no history of headaches, dizziness or faintness. The eyes, ears, nose and throat and mouth are negative for pathology. The two upper central incisors are absent.

There is no history of any pathology referable to the heart and lungs or the genito-urinary tract.

The urine while in the hospital showed a faint trace of albumen, and a few leukocytes, epithelial cells and red cells. On March 13th, there was a slow reduction to sugar with ten drops of urine. The reduction, however, was not present on further examination.

The blood count was as follows: Reds, 4,300,000; Whites, 10,500; Hemoglobin, 94. The Wassermann was clearly negative with acetone insoluble and cholestrinized antigens.

On Saturday, March 11th, the patient was brought to the x-ray department for fluoroscopic examination of the esophagus. The usual fluoroscopic examination of the heart, lungs and mediastinum was done before allowing the patient to swallow the barium suspension. The examination was done with special reference to the posterior mediastinum. In the middle third of the mediasinum there was a very indefinite circular area of density. The shadow was about the size of a dollar, and was thought to be due to some inflammatory reaction, such as a mediastinitis.

The barium suspension in buttermilk was then given. In the middle third of the esophagus there was a definite filling defect with a slight delay in the passing of the suspension. The lumen of the esophagus was irregular; the irregularity involved about two inches of the esophagus. During the fluoroscopic examination, numerous films were made in different positions. The films were later carefully examined. The filling defect was very apparent, and a tentative diagnosis of cancer of the esophagus was made. The following day the films were again studied; we felt that in view of the fact that a primary lesion had been admitted, the possibilities of lues as the cause of the stricture must be considered. In one of the films there was a peculiar regular convexity with a concavity below, and through the barium shadow, a rather dense shadow could be located in several of the films, but nothing could be differentiated. The constant appearance of this indefinite something and the regular concavity and convexity in the esophagus made further investigation necessary.

The patient was again brought to the roentgen department and radiograms were made in the standing position in the left and right oblique position, using a fine focus tube. Stereoscopic films were also made of the chest. During the second examination the patient was again thoroughly questioned with special reference to having swallowed any foreign body, bone or teeth. To all of the above questions he answered in the negative. The films, however, solved the problem and made an accurate diagnosis possible. In the middle third of the esophagus was a partial dental plate containing two teeth.

Figures 1 and 2 show the x-ray films with the plate and teeth clearly outlined. Figures 3 and 4 show the teeth after removal, with a special scale denoting the width of the plate. Figure 5 is the x-ray film demonstrating the filling defect in the esophagus.

After the discovery of the teeth, the patient was told the cause of his difficulty in swallowing and again questioned. He was greatly surprised, but had no recollection of having swallowed them. The possibility of the patient having been under the influence of alcohol was definitely ruled out, as he had not taken a drink for two months previous to the initial symptom. He recalled very vividly having had the plate on February 24th. The following explanation was given by the patient: He felt sure the teeth were swallowed in his sleep. When he missed the teeth, on February 25th, he went back to his room, thinking he had left them on the dresser in a towel. Being unable to find them, he felt the maid had thrown them out with the soiled linen. The maid was questioned, but had no recollection of it, as the soiled linens were thrown into a hamper and sent to the laundry.

On March 13th, Dr. John Cavanaugh was called in to examine the patient and to decide on the method of removal of the foreign body. An esophagoscopy, without anaesthesia, was performed. The patient cooperated very satisfactorily, and after the use of the extension, the foreign body was very readily located. The plate was quite adherent and very careful manipulation was necessary for fear of penetrating the wall of the esophagus. The plate having been in the esophagus for about three weeks, the possibility of necrosis was not to be overlooked. When the forceps were applied to the foreign body, it was necessary to slightly turn it before removal was possible. After the turning, the plate was removed without difficulty.

The patient was then put to bed and nothing was given by mouth for three days, during this time glucose and saline

Fig. 1

Fig. 2

Figs. 3 and 4

Fig. 5

were given per rectum. Morphine was used during the first two nights to relieve the pain and to keep the patient quiet. Four hours after the removal of the plate the temperature rose to 101.6. The pulse also increased to 100. The following day the temperature dropped to normal, and the recovery was uneventful.

On the fourth day the patient was allowed fluids by mouth, consisting of milk, eggnog and coffee. The sixth day soft boiled eggs and cereals were included, and on the tenth day a soft diet was allowed. The day of the discharge, March 22d, a thorough fluoroscopic and radiographic examination was made with special reference to the esophagus and mediastinum. The lumen of the esophagus was quite normal, showing no evidence of a stricture, there was no evidence of any mediastinal involvement.

Conclusions

1. The above report seems to be definite proof that a patient may swallow a large foreign body without knowledge of the occurrence.

2. A careful history may in some cases be misleading. All means at our disposal must be brought to use before deciding upon a definite diagnosis.

3. A careful radiographic examination is of utmost importance in the examination of esophageal conditions and far surpasses fluoroscopy. Every case complaining of difficulty in swallowing should be radiographed in the standing position in both the right and left oblique before the barium meal is given. I feel sure there are a certain number of patients who complain of dysphagia which may be due to some foreign body swallowed years before which they either knew nothing about or have forgotten. The resultant irritation may have caused a scar which is the cause of their present trouble. There is the possibility of malignant changes taking place in the scar.

4. Poorly fitting dental plates should not be used; a plate that has a corner chipped off should be repaired immediately, as the suction is reduced and the plate will not stay in place swallowing may result. Every dental plate, partial or complete, should be removed from the mouth before retiring.

ABSTRACTS and REVIEWS

X-Rays. By G. W. C. Kaye, O.B.E., M.A., D.Sc., F.Inst.P., Superintendent of the Physics Department of the National Physical Laboratory, Past President of the Roentgen Ray Society, Editor of the Journal of the Roentgen Society, Honorable Member of the Society of Radiographers. Fourth edition. Octavo, 320 pp. 126 illus., 1923. Cloth, $5.00 net. Longmans, Green & Co., 4th Ave. and 30th St., New York City; 39 Paternoster Row, London; Bombay, Calcutta, Madras.

THIS BOOK, appearing in its fourth edition, needs no introduction to the radiologist. The author has kept to the same purpose held in previous editions, namely, to give "an account of such of the present day methods and apparatus as appear valuable or novel, and which in many cases can only be found scattered throughout many journals; it deals with the physics of a number of the main principles of radiology, being concerned with the development of theory as well as of experiment; it attempts to convey a notion of the historical trend of events from Professor Roentgen's world famous discovery in 1895 down to the present year." This edition has been extensively revised and some of it has been entirely rewritten. More space has been given to x-ray spectrometry and there is a new chapter upon x-rays and x-ray materials. The author has drawn from many of his recent lectures in his discussion of the application of x-rays. The tables of physical and chemical constants and of some mathematical functions were written by the author and T. H. Laby, M.A.

The work is, to quote the author, "neither recondite nor mathematical." The subject matter is very compactly written, but with the logically presented and easily understood explanations of the phenomena of x-rays the book is fascinating to the intelligent layman as well as to the radiologist. To the latter it is an almost indispensable treatise, containing as it does information which otherwise he would search far and wide to obtain.

The main part consists of 15 chapters with the following headings: Phenomena of a Discharge Tube; Cathode Rays; Positive Rays; X-rays (Discovery and Production); An X-ray Bulb; High Potential Generators; The "Hardness" of a Gas X-ray Bulb; The Blackening of an X-ray Bulb; The Measurement of X-rays; Scattered, Characteristic and Secondary Corpuscular Rays; Further Properties of the X-rays; Practical Applications of X-rays; X-ray Equipment and Technique; Diffraction of X-rays by Crystals; The Nature of the X-rays.

An appendix divided into five chapters gives Sir James Mackenzie Davidson's account of an interview with Professor Roentgen. Following this chapter the author discusses the production of high vacua, electrical insulators, protection of x-ray operators, x-ray and electro-medical terms with notations upon the very newest ones. There is also a chapter giving tables of atomic numbers and weight, densities, values of e/m, cathode ray velocity and potential, wave length and potential, and a table of characteristic rays.

The index is ample, covering almost one thousand topics.

Too Lazy. Abstracted from an Editorial in Southwestern Medicine, 7:135, April, 1923.

THE WRITER of this editorial first quotes Dr. Colcord as follows: "If I were to name the one chief cause of surgical failure, in almost every case it would be laziness. Too lazy to take pains, too lazy to read books and journals, too lazy to visit hospitals and clinics, to attend medical meetings, to learn the newest and best methods. I have said long ago that a lazy man had no business to be a surgeon."

The editor goes on to say that this incident of surgical failure could be applied to every line of medical effort. Many, he says, have grown fat and complacent, thinking their knowledge superior to that of their confreres, and have ceased to read or to attend medical meetings, and he cites the case of a supposedly well informed doctor asking with great surprise regarding a certain method of treatment which had been discussed in medical journals for two years past. The license of any such man, the writer says, should be revoked, as he is not sufficiently well informed to be permitted the responsibility of dealing in human life.

A Clinical and Roentgen Ray Study of Tuberculous Bronchoadenopathy. Thompson Frazer, M. D. and John D. MacRae, M. D. J. A. M. 80:1292, May 5, 1923.

THE data relating to the diagnosis of this lesion in childhood comprise: *a history of exposure* (not of much importance); the *Pirquet skin test* (negative reaction of value in excluding infection, but the positive reaction not necessarily indicative of infection); *symptoms*, of which loss of weight and easy fatigability are the most important in children; *physical signs* (value of these is questionable because as yet the norm for signs in the child's chest is not established); the *roentgen ray findings*, (should not be relied upon to the exclusion of other signs).

The authors submit the following impressions gained in an attempt to determine roentgenologically what is the norm in the child's chest (it must be remembered that what is normal at birth is quite different from what is normal for a healthy child at puberty):

"The chest should be symmetrical, the trachea in the midline, bifurcating in front of the body of the fourth dorsal vertebra or a little lower. The domes of the diaphragm are smooth; the right diaphragm is in front of the eighth interspace, and the left slightly lower. The mediastinal shadow shows the heart to be more nearly transverse than in the adult, and in the very young the thymus shadow is sometimes recognized about the aortic arch when no symptoms of enlarged thymus exist. The hilum, or root, shadow is located in the inner zone, and extends upward to about the fifth rib posteriorly, and downward till it crosses four ribs and intervening rib spaces; its width and density vary very widely in health. The lung fields show no markings in the outer zone, and, in the very young, none in the middle zone.

"At birth, lung markings, i. e., trunk shadows, are absent and the hilum shadow is small.

"As the child gets older, dust inhalations and infections make for more distinct shadows. The hilum shadow is produced by lymph nodes, thick-walled bronchial tubes, blood-filled vessels, and connective tissue binding them together, and it is to be noted that these shadows increase in density and area, whether a history of infections is obtainable or not.

"Lymphadenopathy becomes apparent after the common diseases of childhood, especially those which involve the respiratory tract, such as whooping cough and measles, but it must be remembered that the lymphoid tissues in children are peculiarly prone to react to other infections, notably chronic appendicitis, and diseased teeth and tonsils. At this point let us urge against the tendency to read tuberculosis into films showing large hilum shadows unless these other causes can be excluded.

"There is a group presenting as its salient feature marked hypertrophy of the tracheobronchial lymph nodes, and another group in which the same hypertrophy is associated with calcification of the nodes. All of the first group gave a positive Pirquet reaction and had known tuberculous foci elsewhere in the body. Those with calcified nodes occurred in cases in which tuberculous bone lesions were present, with the exception of one case of osteomyelitis which gave a negative Pirquet reaction. If the roentgenogram had been relied upon exclusively, some faulty deductions might have been made, for all of these children were in good health so far as their chests were concerned.

"We have been struck with the fact that all cases in which bone lesions existed showed marked calcification of hilar lymph nodes, and we submit the question: Does calcification of these nodes necessarily indicate the presence of a tuberculous process?"

Errors in Interpretation of Lesions of the Sinuses. F. M. Law, M. D., Am. J. Roentgenol. 10:301-303, April, 1923.

THERE are disease conditions of the sinuses which often are indicated by other criteria than that of opacity to a greater or less degree. Too often this is the only thing considered by the radiologist in interpreting the plate. Such conditions are most often existent in cases where the symptoms are indefinite and the pathology vague.

There is very frequently a lack of agreement between surgical findings and previous x-ray diagnosis. Some of the reasons for these disagreements the author has discovered and has set forth as follows:

(1) Oftentimes the explanation of disagreement lies in the fact that shortly before the x-ray picture was taken the patient has cleared the nasal passages, completely draining the ethmoids and antra for the time being. The result is a clear plate, followed by a surgical finding of pus if operation is done. Such an examination is not without value, however, for if surgery reveals pus under these circumstances it is clear proof that granulations do not exist; granulations may not be differentiated from pus, as both conditions render the plate opaque, but a clear plate plus a surgical finding of pus indicates that granulations do not exist. Conversely, an x-ray finding of an opaque antrum plus the failure to find pus upon surgical examination indicates granulations. In doubtful cases two examinations should be made.

(2) Another source of disagreement is that fairly frequently there is entire absence of any antrum, giving of course an opaque plate. It is therefore wise to make a plate in an oblique position. Another anomaly, not so frequently encountered, is the presence of a double antrum. In such a case the posterior half may be clear and the anterior half opaque. If the perforation is of the posterior portion the x-ray diagnosis will seemingly be wrong. The same thing may occur in the frontal sinus as well. If such an anomaly does exist careful examination in the lateral position will reveal it.

(3) Again, it is too often the case that the roentgenologist pays too little attention, or none at all, to the outline of the bony structures. The secret of an indefinite pathology will often be revealed right here instead of by some gross lesion. For instance, if the ethmoid capsule is situated far forward and consists of large cells, then an inflammatory condition of the ethmoids may close the infundibulum leading into the frontal sinus. Chronic inflammatory changes cause symptoms difficult for the surgeon to account for but they may often be accounted for by careful study of the quality of bone entering into the septa. If the ethmoidal septa are thinned out, absorbed or thickened it is very often due to a chronic condition that the patient has noticed only recently and has reported as of short duration.

There is always a reason for any difference between the surgical and the radiographic findings, and though this may be difficult to discover, patient, intelligent search will usually reveal it. The gross manifestations, as has been said, should not entirely occupy the attention.

X-Ray Examination of the Chest. Bernard Hudson, M. D. and Percy G. Sutton, M. S. R., The Lancet, 204: 535, March 17, 1923.

THIS paper is based upon the author's experience in the English Sanatorium at Montana, Switzerland.

The normal chest under the fluoroscope will show two upright clear areas which light up more clearly upon inspiration. They are divided by the mediastinal shadow. On each side of this and at the root the hila are seen with their branch-like markings, which may vary considerably. Two dome-like shadows mark the diaphragm at the base, the right one being slightly the higher. These shadows rise and fall with respiration. Normal lung tissue often shows a faint mottling impossible to distinguish from pathological mottling unless one has had experience in this differentiation.

The authors take issue with the view, so widely held, that pulmonary tuberculosis which cannot be discovered by clinical methods cannot be discovered by roentgen ray examination. They have had cases under their care where physical signs were entirely absent in

the chest but where symptoms pointed to tuberculosis, and this was confirmed upon x-ray examination by the finding of glands and masses of infiltration around the hila. Even in cases well established by clinical diagnosis the x-ray will give a much more complete and comprehensive idea of the case than can be formed without it.

The fluoroscope as well as the plate should be employed, as one will often show what the other does not. "By radioscopy can be observed the degree of expansion of the lung, the displacement (if any) of the heart, the range of movement of the diaphragm on each side, and whether that movement is free, hampered or absent, the presence of pleural adhesions, costal or diaphragmatic, and the presence or absence of fluid * * * a very recent tuberculous lesion throws very little if any shadow on the x-ray plate, and the shadow thrown deepens with the age of the lesion and with the amount of fibrotic transformation it has undergone * * *.

"One of the principal uses of the x-rays in pulmonary tuberculosis is when deciding as to whether or not a case is likely to benefit by artificial pneumothorax. Information is gained as to the site where puncture would probably be most succesful, and as to the presence or absence of adhesions. A radiogram is also in our opinion absolutely necessary in order to determine whether or not the other lung is free from disease or at any rate in such good condition that artificial pneumothorax may be reasonably attempted on the diseased side. In the after control of pneumothorax cases radioscopy is of the greatest value; one is enabled by this means to estimate the shape and size of the cavity, whether adhesions are present, the degree of collapse of the lung, and the presence or absence of fluid.

The upright position is the best for fluoroscopy as it permits easy manipulation and more rapid centering of the tube. A costly upright screen is not necessary—the authors use a simple wooden screen of home manufacture.

For radiography of the chest a soft tube is absolutely necessary. The tube should not back up more than a four inch spark gap between points. The exposure must be extremely short, never over two seconds at the most, as the slightest movement ruins a chest plate.

Lastly, an inexpert opinion on a radiogram is of no value whatever and sometimes is even worse in that it is misleading.

The Frequency and Cause of Primary Lung Carcinoma. P. Hampeln, M. D., Mitt. a. d. Grenzgb. d. Med. u. Chir. 36:145-150, Jan. 1923.

THE frequency of primary pulmonary carcinoma is increasing. In Munich there were only eight autopsy cases in the 31 years 1854-1885, while there was at least one case in each of the following nine years. A similar increase is found in the Dresden Municipal Hospital. The author brings data from a number of other cities confirming this increase. Among miners the rate of mortality from primary carcinoma of the lungs has been particularly great. Christiana, Norway is the only exception, as there have been only four cases there within the last twenty years.

The secondary metastatic carcinomata, however, retain the same frequency as heretofore. No increase is noted. While in former days in Christiana as well as at present the number of secondary cases was larger than that of primary cases at the present time, in the cities investigated by the author, the number of primary cases is greater.

This increasing frequency of primary carcinoma of the lungs in large cities, suggested to the author the possibility of an increased dust inhalation being the causative agent. Dust inhalation has been known to cause some lung diseases such as miners' phthisis, etc., so it is quite probable that the constant dust inhalation influences the new growth production by acting as an irritant either mechanically or chemically.

According to Schmorl the increase in lung carcinomata in Dresden is due to the sandstone and mining industries of that city. Pulmonary anthracosis and stone cutter's lung are very frequent there. Damaged bronchial glands, pigment eruption, scarification and stenosis, may give rise to carcinomatosis.

The fact, however, that many cases of primary carcinoma of the lung are entirely independent of the above mentioned industrial condition, but occur chiefly in inhabitants of the large city, is in the opinion of the author, of sufficient evidence to suggest ordinary increased dust inhalation as the cause. Among the author's 41 cases, mostly business men, were one teacher, two pharmacists, two physicians, one consul, and a few clerks and officials.

The author believes that the increase in city population, increased street traffic, increased smoke in the air and other similar factors, are responsible for the increased primary carcinomatosis of the lungs.

A. M. PFEFFER, M. D.

Present Status of Radium in Laryngeal and Oesophageal Cancer in the United States. Henry Hall Forbes, M. D., J. Laryngol. & Otol. 38:1-8, January, 1923.

THIS paper presents a brief summary of the literature and the conclusions reached by several radiologists of note.

Dr. T. J. Harris has expressed (1921) the opinion that radium is useful preoperatively, postoperatively and in inoperable cases but he believes that surgery, whenever possible, is the treatment of choice. Dr. Quick in discussing Dr. Harris' paper said that he believed that with improved methods in radium therapy it would attain a recognized position in the treatment of cases in which operation is doubtful. He considers a preoperative radium essential but is not so positive of the value of postoperative radium. Dr. Lewis of Philadelphia holds the same general views regarding this subject as does Dr. Harris.

Dr. Field of the Radium Institute, New York, stated that he preferred radium needles to suspension laryngoscopy, and he reported nine cases without recurrence for more than a year.

Dr. Freer of Chicago would try radium emanation in laryngeal carcinoma before resorting to laryngectomy or laryngotomy.

Dr. Mills of St. Louis, Dr. Simpson of Chicago, Dr. Hanford of Chicago, and Dr. Greene of Huntington Memorial report encouraging but not conclusive results in radium treatment of esophageal cancer.

The writer describes his own technique.

Endothermy, A Surgical Adjunct in Accessible Malignancy and Precancerous Conditions. George A. Wyeth, M. D., Surg. Gynec. Obst. 36:711-714, May 1923.

ENDOTHERMY was devised and developed by Dr. William Clark of Philadelphia and throughout a period of fifteen years it has steadily proved itself to be of greater and greater value.

It is "a treatment of accessible malignancy which greatly reduces the danger of metastases and the likelihood of recurrence by removing the growth as a necrotic mass instead of as a group of viable cells." The aim in endothermy is to destroy all morbid disease tissue before excising it. Constructive healthy growth then occurs in less time and with less suffering than is usually the case after the use of other forms of physical measures.

Endothermy is the production of heat in the tissues from within. It is a localized production of heat in response to oscillations of the high frequency current and surgeons use it for desiccating and coagulating the tissues. It is often loosely spoken of as the electric needle, the electric cautery, fulguration, diathermy, coagulation, sparking, but not any one of these terms fully describes it. Particularly the author

stresses the fact that endothermy is not fulguration.

In endothermy either the monopolar current (high voltage and low amperage) or the bipolar current (low voltage and high amperage) is used. The former produces desiccation, the latter coagulation. Heat may be applied where and to whatever degree is wished —"It can be throttled down practically to a pin-point area, permitting one to work in the cornea of the eye or in the vocal cords." It neither chars nor burns. The active electrode is cold when applied, the resistance of the tissues to the current produces the heat and is penetrative according to the strength of the current and the length of time applied. This is in contra-distinction to heat applied by the Paquelin cautery, the galvanocautery and fulguration as advocated by de Keating and Hart.

Monopolar endothermy is of great value in lupus vulgaris, all forms of tuberculosis of the skin and mucous membranes, vernal catarrh and leukoplakia. Epitheliomata can be removed and the method is of value also in precancerous dermatoses, including the various forms of keratoses, acanthoma, chronic ulcers, papilloma, fibroma, lupus erythematosus, and in x-ray dermatitis.

In monopolar work the needle lightly penetrates the lesion to be destroyed, but in deep seated malignancy bipolar endothermy is used and the needle is thrust to whatever depth is desired.

"Heat is generated by connecting one pole of the machine to a well-wet, indifferent electrode under the patient's buttocks as he lies upon the table. The other pole, the active electrode, is attached to the handle, in which is an ordinary sharp-pointed, steel darning needle of proper length and suitable shape. With this in hand any amount of coagulation necrosis can be described. In the squamous-cell variety of epithelioma and the more malignant and persistent forms of accessible cancer (particularly the lesions in and around the mouth, which metastasize early, are difficult of removal by the knife, and are uncertain in their response to physical treatment) endothermy is of the highest value. Lip lesions are removed under local anesthesia. Any portion of a tongue can be coagulated and immediately cut away. A floor-of-the-mouth cancer can be coagulated in situ and the necrotic mass removed in one operation. Bony structure, alveolus, hard palate and portions of the lower jaw likewise can be treated with the same degree of precision." Dosage is always under control and over treating is better than under treating which may stimulate growth.

If properly done there should be no hemorrhage but if it does occur it can be controlled by focusing the current for a second or two. Endothermy provides a protective ring of destruction around the malignant area, the blood vessels and lymphatics to and from the affected part are shut off and destroyed as are also the sensory nerves. After this has been done the lesion itself is destroyed and removed.

In hopeless cases the method gives great relief from pain and from the offensive conditions so often present; particularly in mouth conditions are these benefits appreciated.

Analysis of End-Results in Thyroid Surgery. Charles A. Porter, M. D., Surg. Gynec. Obst. 36:621-640, May 1923.

THE series here presented began in 1904. The author's summary of his article reads as follows:

1. "I believe that the x-rays through the action on the thyroid, and possibly on the thymus, will diminish the risk of operation and will permanently cure certain cases of Graves' disease. On the other hand I have seen cases in which x-ray treatment, though persisted in for as long as two years, has had practically no effect. Surgery promptly cured.

2. "If six months' treatment with x-rays is not effective, operation is indicated.

3. "The best index of a cure of Graves' disease is a permanent reduction of the basal metabolism to normal.

4. "Whether the patient will be cured or not depends on the stage of the disease at which treatment is instituted and the degree of irreparable damage which has already resulted.

5. "Though litigation and hemithyroidectomy may cure many patients, ultimate subtotal thyroidectomy most quickly and permanently reduces the metabolism to normal.

6. "The psychoses of this most interesting disease, which seems frequently to occur in neuresthenic individuals, requires long after treatment."

Further Observations on the Roentgen Ray Treatment of Toxic Goiter. J. H. Meand, M. D. and G. W. Holmes, M. D., Arch. Int. Med. 31:303-341, March 1923.

THIS paper includes description of methods, case reports and a mass of data thereon. The authors' conclusions are as follows:

1. "We believe that the data presented here show that the roentgen ray probably has a beneficial effect in toxic goiters, and that for that reason it has its place in our armamentarium for treating these diseases.

2. "About two-thirds of the patients with exophthalmic goiter so treated show either recovery or improvement coincident with the treatment. The remaining third neither improve nor grow worse.

3. "In exophthalmic goiter, when treated by the roentgen ray, if good results are not secured in a few months, surgery should be employed. Prolonged roentgen ray treatment in patients showing no response is undesirable. This is a fact which has been impressed on us particularly in our recent work. We have not emphasized it before, and therefore do so now.

4. "Some patients with exophthalmic goiter who are not cured by the roentgen ray are, perhaps, made better operative risks by it. A combination of the two forms of treatment may sometimes accomplish more than either does alone.

5. "In toxic adenoma there seems to be a similar improvement to that noted in exophthalmic goiter, surgery probably removes the actual cause of the disease, the adenoma. The indication for surgery would, therefore, seem more definite than in exophthalmic goiter. Even in toxic adenoma, however, in certain cases that are too thyrotoxic for safe operation, the roentgen ray may be used to advantage.

6. "To make a proper use of the roentgen ray in the management of toxic goiter of either variety, its limitations should be recognized and it should be intelligently correlated with other therapeutic measures as the individual case may demand."

Prompt Action of Radium Radiations in the Treatment of Small or Large Infected Tonsils and Lingual Tonsils. Francis H. Williams, M. D., Boston M. & S. J. 188:497, April 5, 1923.

DR. Williams reports great relief afforded patients suffering from infected tonsils when these are treated by radium. The treatment is harmless and its use for the last two years has proved satisfactory. Operation can often be avoided and this is at times desirable.

The Diagnosis and Treatment of Thyroid Disease as Controlled by the Metabolic Rate. Albert H. Rowe, M. S., M. D., Endocrinology 7: 257, March 1923.

THIS paper gives neither unqualified praise nor unqualified condemnation to x-ray therapy used in hyperthyroidism. The author says that a goiter should not be treated by x-ray after the metabolic rate has become normal or when it is fast approaching normal, neither should the rays ever be administered when a crisis is approaching as

indicated by an increased metabolic rate and symptoms, nor when the rate remains stationary at a high level of 80 per cent or more; if the rate is 70 per cent and is increasing radiation should not be used; medical treatment should be given to lower the rate before radiation is given. The author has drawn this latter conclusion from the unfortunate termination of three such cases in his practice.

Finally, whenever x-ray treatment is used the results should be checked by repeated tests of the metabolic rate.

Report of a Case of So-Called Marble Bones with a Review of the Literature and a Translation of An Article. William G. Alexander, M. D., Am. J. Roentgenol. 10:280-300, April 1923.

THE author reports the case of a woman, 43 years of age, in whom there was such a high degree of calcification of all the bones of the body that they presented a stone-like picture, although without any change from normal contour. At first examination the author found himself at a loss to explain the condition in any way. Not long after the patient had reported to him, however, there appeared in the German literature a report by Fritz Schulze of six similar cases which he had found in a search of German literature. Portions of this report are reproduced in the article here abstracted and give details of the six cases, patients of Schulze, Sick, Lorey, Albers-Schoenberg, Laurell and Wallgren.

The etiology of this condition is not known although it is thought by Dr. Alexander that a disturbed kidney function may account for it. The changes found allowed no definite classification under any known disease of the skeleton; osteomalachia, rickets, etc. were all ruled out.

The Diagnosis of Sarcoma in Bone. Eugene H. Eising, A. M., M. D., J. A. M. A. 30:1429, May 19, 1923.

GENERALLY speaking, new bone resulting from an inflammatory process will be found laid down in lines parallel to the axis of the bone, but when due to neoplastic irritation it is found in plaques or spicules at right angles to the axis.

The author says that the x-ray picture of bone sarcoma must be studied from the standpoint of bone striving to protect itself against invasion, and not from the standpoint of the tumor alone.

In very early pathology the changes in the bone do not show in the plate (not for a week in osteomyelitis, and not for much longer in neoplasms.)

Complaint is made that in the literature of bone pathology one finds a confused terminology, incomplete clinical reports, too few histological examinations and a single roentgenogram when a series should have been made.

Roentgenological classification of bone pathology has not yet been satisfactorily done. The author believes that in the nature of the tissue there never can be any hard and fast rules laid down for roentgenographic diagnosis of bone lesions.

An Efficient Method of Applying Radium within the Mouth. E. Wood Ruggles, M. D., J. A. M. A. 80: 1374, May 12, 1923.

IT is not only wearisome to hold radium in one position for hours when treating an oral lesion but it is practically impossible to hold it in exact position for any great length of time.

The author hit upon the device of attaching a radium plaque to the end of an ordinary white pine tongue depressor by means of adhesive plaster, then placing a similar depressor exactly opposite on the outside of the mouth. A rubber band was twisted two or three times to give adequate pressure and was slipped over the outside of the depressors to about the middle point. A block of wood about one-half inch thick was then inserted between the outer ends.

The device works very satisfactorily. The pressure produces neither pain nor great discomfort and the plaque remains in exactly the same location indefinitely. In treating lower lip lesions a cord can be looped over the head and attached to the ends of the plaque to avoid downward tension on the lip.

Cancer of the Prostate. George Gilbert Smith, M. D., Boston M. & S. J., 188:621, April 26, 1923.

OBSERVERS best qualified to know estimate the percentage of prostatic cancer at 20 per cent. Wilson, McGeath, Judd and Young are cited as agreeing in this estimate.

For any success in treatment early diagnosis is necessary and must be followed by surgery with radium as an adjunct. Radium alone is not sufficient. If used alone and in a powerful enough dose to kill the cancer there will be a sloughing, infected area without sufficient drainage.

The Clinical Results of the Treatment of Malignant Disease by X-Rays. J. H. Douglas Webster, M. D., M. R. C. P., Physician in Charge of the Department of Radiology, Middlesex Hospital, London. The Lancet, 204:373-378, Feb. 24, 1923.

RESULTS of radiation treatment should be tabulated according to the aim of treatment whether prophylactic, palliative, or curative. Any other basis of judgment is not a fair one.

In superficial basal cell epithelioma the aim is curative and cure will result in the majority of cases properly treated. Failure may result from several causes, among which may be mentioned failure to irradiate sufficiently the deeper strata of cells, failure to include a wide enough area beyond the visible and palpable extent of the lesion, and failure for any reason whatsoever to follow up cases which are apparently clinically well.

In squamous cell epithelioma results are not so good as in the superficial basal cell type, as frequently there is early wide invasion and the primary tumor is very resistant.

In breast cancers so many factors are involved and statistics leave out so much that is vital that it is difficult to present any sure conclusion except to say that in general the best results follow surgery plus radiotherapy. A very condensed but albeit comprehensive review of the literature is given.

In growths of the mediastinum a few clinical cures are reported and a large proportion of cases have shown temporary benefit. Testicular and prostatic cases are difficult although some encouraging reports have been received.

In gynecological conditions practice and opinion differ widely. The literature upon this subject is also rather extensively reviewed in a condensed form.

Gastric cancer was first to be treated by x-ray therapy (1896) and will probably be the last to yield to that or any other form of therapy. Radiation is advised, however, after partial gastrectomy. Surprising results sometimes follow treatment of primary cases.

X-rays should be tried in the following sarcomata: All inoperable cases (even glio-sarcoma of the brain); lymphosarcoma; periosteal sarcoma of the pelvis, shoulder or limb joints; myelogenous sarcoma and skin sarcoma should first be radiated and later, if necessary, surgery may be resorted to. Maxillary sarcomata are difficult to radiate and should be operated if this is possible.

In general what the author considers cautious, progressive present-day opinion is thus expressed (from Schmieden): "(1) With few exceptions every operable carcinoma should be operated upon, with prophylactic postoperative radiation in addition. (2) In addition to postoperative radiation a single intensive radiation before operation is coming to be considered important. (3) Practically all inoperable carcinomata and all inoperable recurrences should be radiated. This gives in many cases clinical cure, in others it results in opera-

bility, often less bleeding, irritation and pain, as well as limitation of further metastases. (4) Facial carcinomata, even when operable, can well be treated exclusively by radiation, for cosmetic reasons. (5) Sarcomata, as a rule, should only be radiated, certainly in all cases in which operation would cause considerable bodily mutilation. (Any increase in size of the tumor after an efficient radiation should not be considered proof of failure to respond, it is usually only temporary)."

There are at least six possible lines of advance in radiation therapy and the author thus describes them: "(1) In the engineering and electrical workshop, improvement of apparatus in power and reliability. (2) In the physical laboratory much remains to be done with measurements of dosage, standardization, calculation of scattered radiation and absorption in animal tissues. * * * the physical side of biological radiation effects; (3) In the postmortem room and the pathological laboratory, more statistical and experimental work; apart from immunity and gross animal tumor work, the histological reactions to radiation, as Ewing says, seem to require the combined genius of a Waldeyer, a Weigert, and a Virchow to elucidate them; here new methods like vital staining may be of use; and there is a very wide range for biochemical investigation as to the radiation effects on basal metabolism, etc.; (4) Clinical technique is a most important branch requiring much further working out. * * * Auxiliary technique such as diathermy, ionization, radiation stimulation (ductless gland) dosage, or general minimal repeated radiation or other means for stimulating the patient's immunity requires much further research. (5) In relation to surgery * * * Much still has to be learned as to the value of pre- or postoperative radiation, or both * * (6) Finally, auxiliary medical measures require much further investigation; though about 100 substances have already been tried, still in this sphere, some day, may be discovered what may displace both surgery and radiation in the treatment of malignant disease. At present the general management of the cancer patient is too often neglected; open air, exercise, diet are not unimportant in recovery, and the role of hematinics, colloid, protein, and animal extract injections or transfusions, and of drugs such as arsenic, iodide etc., is little understood yet."

Pneumoperitoneum. Humberto H. Carelli, M. D., Am. J. Roentgenol. 10: 259-279, April 1923.

DR. Carelli has employed pneumoperitoneum in the examination of more than 800 patients and in no case has there followed any ill effects. The ill effects ascribed to the method by others who have used it he ascribes to faulty technique, lack of proper equipment or lack of a thorough clinical examination beforehand.

The needle must be entered at the right spot and one must wait to see that blood does not flow through the needle The simplest rules of asepsis will prevent peritonitis. Contra-indications to the use of this method are cardiovascular troubles or insufficient myocardium, old age (as a rule), cachexia, extreme obesity, acute inflammations of the abdomen, hysterical tendency, also the method must not employed in those patients where a tumor or tension does not permit further extension of the abdominal wall.

The shock to the patient is far less than that of exploratory operation, and the results are far more comprehensive.

Technique: A purge is given for two successive mornings, castor oil the first day and a saline purge the following one. The patient is kept upon a watery diet these two days and upon the third day the intestines and bladder are emptied and the examination is made.

A long thin platinum needle is introduced into the abdomen at a point one or two finger breadths below the naval on the linea alba. If there are scars here from a previous operation, then the needle must be introduced elsewhere. If blood does not flow the needle is then connected with the tube conveying the oxygen, which is passed in rather slowly, from two to eight liters being used according to the size of the abdomen, flaccidity of the walls, etc. The patient must not be allowed to alter his movements by himself during the examination. After the examination the oxygen is withdrawn by a flat trocar and the patient gets down from the table without assistance and without complaint.

Perirenal Insufflation is thus described: "After having taken a first roentgenogram with metal guiding points on the patient's skin, one fixes on the point which corresponds to the transverse process of the second lumbar vertebra.

"A fine platinum needle, 10 to 12 cm. in length, is introduced down to this process (of cource according to the rules of asepsis). As soon as this process is encountered, the needle is made to deviate so as to avoid it, while watching the manometer of the injecting apparatus, and as soon as the manometer shows oscillations, one knows for certain that the needle has entered the perinephric cellular tissue. One then commences to inject the gas which is to produce the artificial emphysema.

"This injection is made with a Forlanini apparatus or the *Oxygenateur de Precision du Docteur Bayeux*. I used to employ carbonic dioxide, but I found that the absorption was so rapid that it did not allow sufficient time for taking several plates. For this reason I now use oxygen instead of carbonic dioxide.

"This operation is not painful. The patients experience a certain amount of discomfort in the lumbar region, but that ceases within an hour.

"The quantity of oxygen one injects varies from 200 to 600 c.c. according to the size of the patient."

The text of this article covers about three pages, the remaining 17 are occupied by 87 illustrations, mostly of pathology as revealed by the method.

The Importance of Pyelography in Recognizing the Causes of Obscure Abdominal Symptoms. Richard F. O'Neill, M. D., Boston M. & S. J., 188:671, May 3, 1923.

PYELOGRAPHY, while not free from danger and discomfort, is a useful and necessary procedure at times, and the dangers may be minimized to a great extent.

The author uses sodium iodide, 12½ per cent solution, in his work. The patient should be hospitalized as it is necessary that he be kept quiet for several hours after the procedure. The fluid is injected slowly and injection is stopped as soon as any indication of discomfort appears as the restlessness and possible internal spasm resulting from discomfort may spoil the picture.

Simultaneous bilateral pyelography is not regarded as wise, as alarming anuria may follow. If desired the second picture should be taken at another sitting. An ureterogram as well as a pyelogram should be taken in all cases. This is done by withdrawing the catheter and injecting the ureter.

Pyelography should not be performed in cases complicated by tuberculosis, acute urinary infection, nor in large hydronephrosis when the diagnosis is obvious by ordinary ureter catheterization; neither should it be done in the presence of cachexia nor in those patients who react violently to instrumentation.

Mistakes in interpretation are easy to make in this work. Often what appears to be an abnormal renal pelvis may be a filling defect due to an insufficient injection (inject more fluid and develop plate at once). A blood clot in the renal pelvis may lead to a mistaken suspicion of renal tumor.

Three case reports are submitted. These are of patients who complained of pain in the upper quadrants of the abdomen but in whom physical examination was negative and in whom no urinary symptoms were found but upon

pyelography pathology was revealed in the urinary tract. In these cases the symptoms were thought to be due to pathology elsewhere.

Occasionally a tumor or cyst may be found involving the lower pole of the kidney without encroaching upon the renal pelvis. "Here we might have a normal renal pelvis and the pyelogram would fail to show any lesion of the kidney. Such cases are rare and the diagnosis will have to be made by palpation or x-ray or by exploratory operation. Such a cyst or tumor in the upper pole would cause a downward displacement of the kidney, which would be at least suggestive of renal involvement although such displacement might be caused by a retroperitoneal tumor."

Principles of Radiotherapy of Carcinomata Especially of Uterine and Mammary Carcinomata. E. Opitz, M. D., Am. J. Roentgenol. 10:312-319, April 1923.

THE author's summary is as follows:

1. "Retrogression of the cancer is not solely due to the local action of the rays, but it is to be considered as a function of the whole organism that has been attacked by cancer. The organism is activated by the irradiation.

2. "The elements of these activating forces are contained in the healthy tissues surrounding the cancer, the blood, and probably also the endocrine glands, including the spleen (reticular-epithelial apparatus.)

3. "A carcinoma dose according to the definition of Seitz and Wintz, that is to say, a curative action upon every variety of cancer by a dose of rays of from 90 to 100 per cent of the erythema skin dose, does not exist. However in the majority of the cases of mammary and uterine cancers a retrogression may be expected from the administration of this dose (Holzknecht). This carcinoma dose proposed by Kroenig is therefore still useful.

4. "Experience teaches that frequently repeated irradiations with a dose which does not quite reach the amount of the carcinoma dose are productive of the best permanent results. The most favorable results are observed from a combination of radium and x-rays.

5. "An over-dosation is to be considered as especially dangerous because it weakens the local as well as the general defensive forces of the body.

6. "The posological question requires an elucidation on account of the systemic action of the rays.

7. "The therapeutic effects of irradiation can be augmented by the employment of various auxillary remedies." (The main text explains that this is not accomplished by copperization but by catalytic or other activating means).

8. "The best results are only obtainable if the method of irradiation is adjusted to the particular conditions of each individual case."

Deep X-Ray Therapy in Gynecology. Report on the Obstetrical Section of the Royal Academy of Medicine in Ireland, February 23rd. Brit. M. J. 2:418, March 10, 1923.

DR. G. E. Pepper in his paper described the "symmetrie" apparatus of Seitz and Wintz. The essential points of this apparatus are the division of the coil into two symmetrical parts, "and the inclusion in the circuit of two water resistance tubes, with an inclosed point and plate spark gap so as to destroy all oscillations and inverse currents and to prevent formation of poisonous gases."

He emphasized the great necessity and also the difficulty of measuring the dosage and estimating the penetration of the rays by means of the water phantom.

The combined use of x-rays and radium was advocated in treatment of malignancy.

The action of x-rays on malignant cells is said to be due to the ionization which causes lecithin to split up and liberate cholin which poisons the cells.

An Instrument for Measuring Distortion Due to the Divergence of X-Rays. Eben C. Hill, M. D., Bull. Johns Hopkins Hosp. 34:164-168, May 1923.

DIAGRAMS illustrating the apparatus are given in the original paper which discusses the necessity of measuring the distortion, relates experiments and the history of the evolution of this device and gives a description of it. The author's summary is quoted below:

1. The development of stronger, more dependable x-ray tubes and machines, together with such accessories as the intensifying screen, has made possible at last a study of divergence of roentgen rays.

2. A movable diaphragm has been introduced and later modifications were made. These diaphragms remove to a certain degree the effects of secondary radiation and distortion, but there is no method for direct correction of errors.

3. The many sources of errors in diagnosis due to distorted images from the secondary and broad focus rays and to various other mechanical conditions are discussed.

4. A description, with illustrations, is given of an instrument which has been found to give accurate scientific measurements. Its usefulness is in no way dependent on the time element so necessary in the diaphragmatic devices and there is no complicated synchronism between the length of exposure and the movement of the diaphragm.

5. Calipers applied to shadows of the measuring plates and the scale quickly gives the actual errors in the shadows of the part radiographed.

6. The simplicity of the instrument is self evident. By its use, in wrist measurements, where radiographic determinations at a one meter target distance as compared with dissections of the same parts showed about eight per cent error, exact control was afforded.

Concerning the Changes and the Outlook in Radiotherapy. Otto Strauss. M. D., Deutsche med. Wchnschr 48:1574, Nov. 24, 1922.

DR. Strauss points out that there is really no "carcinoma dose" and that though in certain forms of pathology a certain dose is almost sure to give a result practically identical in each case, yet the term, even for a specific pathology, must be understood as only approximate in meaning.

Large doses having been found injurious to the general resistance of the body, many workers have reduced the dosage. The author does not concur in this practice; he believes that strong dosage is necessary in the primary tumor and that in postoperative treatment, much weaker ones should be used, to stimulate general resistance. He advances the theory that the secret of successful cure may be found in the quality of rays rather than in the quantity. He does not regard as plausible the theory that large doses are injurious to the endocrine system.

As to the part played by connective tissue in the destruction of cancer cells, the author believes this has been overestimated. If the chief effect of x-rays were secured through the connective tissue then scirrhus forms of malignancy would be the most benefited by treatment—which is not the case.

The Use of Radium in the Treatment of Disease. Dawson Turner, M. D., Brit. M. J. 2:464, March 17, 1923.

IN the Edinburgh Royal Infirmary the principal conditions in which radium has been found useful (besides in malignancies) are exophthalmic goiter, splenomedullary leukemia, Hodgkin's disease, keloids and nevi.

The most amenable of these are rodent ulcers, epitheliomata, lympho-sarcomata, spindle celled sarcomata, malignant disease of the cervix, sarcomata of the nasal passages, exophthalmic goiter, early keloids, and certain nevi.

Barium Plaster Protection Used in the X-Ray Department of the Manchester Royal Infirmary. From "The Organization and Equipment of An

X-Ray Department" by A. E. Barclay, M. D., J. Roentgen Soc. 19: 55-78, April 1923.

AN abstract of Dr. Barclay's paper was published in the March number of the Journal (see page 95). In this paper the substitute for lead was made mention of. The formula is here given and is as follows:

1 part commercial barium sulphate

1 part Portland cement

1 part sharp well-washed sand

This is mixed dry and water added as necessary. Lay on plaster to half an inch at first, and when dry finish up to three-quarters of an inch. The wood framing should be covered with lead unless provision is made for allowing the plaster to cover it.

Plastering one side of the wall ¾-inch thick gave a minimum lead-equivalent of 3.5 mm. and a maximum of 4.5 mm., at least it was so thought at first but subsequent measurements by the National Physical Laboratory gave lower figures. The treatment cubicles were plastered on both sides a total thickness of 1½ inches of plaster and these tested an average of 8.5 mm. lead.

Since the first report of this new laboratory was made the red lights of the dark room have all been replaced with the new Thorne-Baker green glass giving an extraordinarily plentiful, slightly green light which is proving itself to be most satisfactory.

Some Points in the Physics of the X-Ray Tube. G. W. C. Kaye, O.B.E., M.A., D.Sc., J. Roentgen Society 19:84-87, April 1923.

NO difference in principle exists between the x-ray tube of 1895 and that of today. It still remains a device for generating high velocity electrons and suddenly depriving them of that velocity by hurtling them against a target. In an apt figure the electrodes are likened to shells which burst, and in place of flames x-rays break forth.

The factors controlling the output of the general or continuous spectrum of rays are "(a) the number of the cathode rays or electrons which strike the target, (b) the speed of the electrons, (c) the massiveness of the target; (a) is represented by the current through the tube, (b) by the voltage across the tube, (c) by the atomic weight, or more precisely, the atomic number of the metal of the target."

The x-ray spectrometer shows that the x-ray output is proportional to the current, to the atomic number of the target and to the square of the voltage.

Applied voltage dominantly affects the output and is the only arbiter of quality or penetrability or wave length, and it must be measured routinely every day.

It is becoming more and more necessary to discard the terms "hard" and "soft" rays and to speak of wave lengths and the author suggests that radiologists might "make a beginning, for example, by agreeing that 'hard' rays refer to rays with wave lengths shorter than 0.1 Angstrom units and that 'soft' rays have wave lengths longer than 0.3 Angstrom units, the intervening rays being of 'medium' hardness."

The chance that an electron in an x-ray tube will come into suitable conflict with an atom of the target and thus generate x-rays is only 1 in 1000; the electric energy is more apt to be frittered away in heat. If the electron does strike an atom of the target it will either lose all its energy at one encounter or will lose it by installments in a succession of encounters, i. e., it may lose all of its original driving voltage in one step or in a number of steps.

The wave length of the x-ray generated is inversely proportional to the amount of energy (propelling voltage) lost. If all energy is transferred by one encounter then the result will be the shortest wave length x-rays possible to that voltage. These rays will of course be accompanied by a variety of wave length x-rays possible to that voltage. These rays will of course be accompanied by a variety of wave lengths depending upon the energy lost by other electrons which have not lost all their energy at one contact.

Thus it is seen that constant potential does not produce homegenous x-rays even when all electrons hit the target with the same velocity. However, the efficacy of constant potential is superior as the x-ray spectrometer proves. If the potential is constant the proportion of short waves is greater than if the potential were fluctuating, the peak value of which is equal to the constant potential.

Furthermore it is shown by the spectrometer that the minimum wave length in Angstrom units multiplied by the maximum voltage is equal to 12, 350. This scale though perhaps not perfect is more exact than any which is generally used. In a typical spectral curve of x-ray emission the shortest waves dominate, especially if the normal type filters are employed. The mean effective wave length of a spectrum of rays approximates the wave length of the peak of the curve, i. e., the wave length of maximum density. It is thought that the peak wave length of the peak is proportional to the limiting (quantum) wave length and so the quality of a mixed bundle of rays can be fairly well identified. Standardization of application and technique so as to use only three or four spectra the distinctive features of which could be determined and specified would enhance the precision of this method.

There are many difficulties to be overcome before the new 500,000 volt tubes can be put to practical use. A more robust x-ray tube will have to be provided. There is room, in fact in almost every section of x-ray equipment, for improvement. The overall efficiency of present x-ray equipment is of the order of 1:800,000 assuming that half the rays emitted by the bulb are utilized.

The ideal in radiography as expressed by the author is: "To make the process as simple and noiseless as taking an ordinary photograph. The patient should hear nothing untoward, the apparatus should look no more formidable than a camera. Sparks and brush charges should be taboo; the rumble of rotating machinery anathema. Standardized technique must be the order of the day for much of the radiographer's work. The number of variables must be cut down."

Standardization of X-Ray Exposure Identification. Edw. S. Blaine, M. D., Am. J. Roentgenol. 10:303-306, April 1923.

ANY system of marking films which permits of mistaken identification of any film may lead to serious consequences. One illustration cited is of an operation done for renal stone where none was present, all due to the films of two patients having been confused.

The vital requirement is that the identification be exposed upon the plate or film at the time the exposure is made of the part examined. To determine rights and lefts without special markings the marker should routinely be placed facing the tube target no matter what the position of the plate. The following information should be given indelibly:

Name of hospital, city, roentgenologist, date of exposure, name of patient, name of referring physician, serial number of case.

A stencil machine can be operated at little cost to produce the necessary markings.

In justice and fairness as well as for medicolegal reasons, inerasable, indelible markings should be used.

Simulation of Diverticulum of the Duodenum by a Calcified Mesenteric Gland or by Calcification in the Intestinal Wall. Dr. Lotsy, Cairo, Egypt. Fortschr. a. d. Geb. d. Roengenstrahlen 30:212-214, February 1923.

IN the course of a routine gastro-intestinal examination a rounded opaque shadow was observed which was partly within the shadow of the visualized duodenum and partly outside of it. Manipulation failed to separate

that shadow from the one of the duodenum, although it could be moved about freely. This shadow remained even after the onward passage of the contrast meal which passed alongside it.

Differentiation: (a) Right renal calculus was excluded by the free movement of the shadow on manipulation.

(b) There were several arguments against its being a biliary calculus. First, the nature of the shadow; instead of a lesser opaque central cholesterin shadow within a more opaque calcium covering, this was a strongly calcified homogeneous opacity. Secondly, such a strongly calcified calculus could only have been present in an inflamed gall-bladder which would not permit such free mobility. There were no symptoms of cholecystitis or an enlarged liver with palpable gall-bladder.

(c) The highly marked homogeneous calcification and the sharp outline of the shadow was against the probability of a calcified mesenteric gland.

The fact that manipulation failed to separate the opacity from the duodenal shadow, that the meal passed alongside it, and that it remained after the complete evacuation of the meal, suggested the diagnosis of a duodenal diverticulum as highly probable. Unfortunately no examination was made previous to the ingestion of the barium suspension.

Three weeks later the patient reappeared for examination. The opacity was still present—this fact being sufficient to eliminate the probability of a diverticulum.

This patient had had a long standing bilharziosis, and the author assumed that the shadow represented either a calcified mesenteric gland or a calcification of Bilharzia ova in the wall of the duodenum.

A. M. Pfeffer, M. D.

The Pulsatory Movements of the Diaphragm. Karl Hitzenberger, M. D., Wien. Arch. f. inn. Med. 5:451-472, January 1923.

THE literature on this subject is reviewed by the author.

Schwarz and Dietlen observed (roentgenologically) rhythmical, systolic twitching of the dome of the diaphragm in some cases of pleuropericardial adhesions, and concluded that in those cases there must have been some adhesion between the apex, and the pericardium. This phenomenon was observed only in the left diaphragm.

Achelis noted this phenomenon in adhesive pericarditis even when there were no visible adhesion bands between the heart and the diaphragm.

Bordet and Vaquez observed tension of the diaphragm with every systole in cases manifesting the Broadbent signs. Cohn was the first to describe pulsatory shaking of the diaphragm and the visualized stomach in aortic insufficiency.

Holzknecht observed a type of right diaphragm movement peculiar to tricuspid insufficiency, a pulsation transmitted by the venous liver pulse.

In his own investigations the author found that the pulsations of the diaphragm which can often be observed in healthy people, and which are more characteristic in the above mentioned pathological conditions, are best elicited in experium with cessation of breathing. The author explains this phenomenon by the fact that in inspirium the diaphragm is in marked tension and does not respond to lightly transmitted movements while in expirium it is in a relaxed condition.

Pulsations of the right diaphragm are best elicited with the patient on the left side.

Using various methods, such as the combination of apex palpation or auscultation with screen observation, the author was able to time the pulsatory movements of the diaphragm with relation to the systole and diastole of the heart. He made observations on the normal subjects, and in subjects with various types of cardiac pathology.

The following summary was made by the author:

1. Under physiological relations one can observe pulsatory movements of the diaphragm, particularly distinct in the right side, in the standing subject in the expirium. The pulsations correspond to a negative venous pulsation of the liver. Their components are a slow presystolic upward movement and a rapid downward movement. The first component corresponds to the "a" wave, while the second one corresponds to the systolic collapse of the normal venous pulse.

2. The left diaphragm is to be considered in two separate parts: the medial, lying beneath the heart, and the lateral. The first one pulsates more strongly in inspirium and rises with the heart systole. The lateral is at rest or follows the medial portion, less feebly.

3. In valvular defects with the exception of tricuspid insufficiency and auricular fibrillation the diaphragmatic pulsations are the same as in the normal.

4. In tricuspid insufficiency one can observe a systolic and diastolic rise and fall of the right diaphragm as the expression of the positive venous pulse.

5. The pulsations of the right diaphragm in auricular fibrillation are of the same nature as in tricuspid insufficiency in the presence of a positive liver venous pulse, otherwise the fall is not in diastole, but in systole.

6. Pulsations are changed in presence of anomalies of the position of the diaphragm.

7. In pleuropericardial adhesions in the right cardiohepatic angle, one sees upward twitching of the right diaphragm in systole.

8. Obliteration of the pleurae and fixation of the diaphragm to the thoracic wall abolish pulsations of the diaphragm.

A. M. Pfeffer, M. D.

Effects of Irradiation on Fetal Development. Harold Bailey, M. D. and Halsey J. Bagg, Ph. D., Am. J. Obst. & Gynec. 5:461-473, May 1923.

THE authors thus summarize this paper: "We have attempted in this paper to bring together the experimental and clinical studies relating to the effects of radium and x-ray irradiation upon the functional activity of the ovary and the reaction upon the developing fetus, when irradiation is given before or during the various stages of pregnancy.

"As previously stated in detail, the experimental data upon the lower animals have shown that when the sex glands are sufficiently irradiated *before* fertilization the following are typical fetal reactions:

1. Disturbed, abnormal, arrested development, resulting in the formation of monsters conforming more or less to a general type, and pronounced disturbances in the development of the central nervous system (Bohn, Perthes, O. and G. Hertwig, Schaper, Tur, Bordier and Baldwin).

2. A marked tendency to a progressive loss of fertility.

3. A specific modification of the hereditary mechanism (Mavor) and the production of inherited defects in the young, especially in the eyes (Little and Bagg).

"Irradiation during pregnancy produces the following typical disturbances in fetal development, depending upon the developmental period at which the irradiation is instituted: Disturbed, arrested abnormal development with death of the embryos, absorption or abortion, stunting in growth, cataract, sterility, lesions of the central nervous system and blood vascular disturbances in the embryos (Hippel and Pagenstecher, Regaud, Nogier and Lacassagne, Lengfellner, Krukenberg, Cohn, Walter, Bagg, Hansen, Lacassagne and Coutard).

When we come to a discussion of the clinical reports it must be borne in mind that the data cannot be presented with the same scientific evaluation that may be given to experimental biologic studies, and although we realize that one cannot directly transfer the experimental results from animal to man, yet we believe that there is no reason for considering human developmental pro-

cesses as essentially different from those of other mammals, and it has been our aim to bring together the clinical reports to interpret and correlate them as much as possible, and to add our six cases. We are fully aware that developmental disturbances are to be found in many instances of human ontogeny where irradiation has never been applied, and we wish to caution those who contemplate the irradiation of women during the child-bearing period with a view to preserving the procreative ability.

"In judging the clinical reports we believe that in those instances where comparatively great disturbances have resulted in the child, the irradiation was given early in pregnancy. Here we would place the children with subnormal mentality and other defects reported by Aschenheim and Stettner.

"We believe that irradiation during early pregnancy may produce death and abortion of the fetus, and we would place in this group the four abortions reported by Clark and Keene, two by Stacy and nine by Weiner.

"Irradiation in late pregnancy is not so likely to produce gross developmental abnormalities in the child at birth, but the clinical data seem to agree with the experimental in several instances where children irradiated *in utero* at this period have been prematurely delivered, or have shown postnatal growth disturbances, or death within the first year. Werner reported three such retarded children, and four that died during the first year. The second child we reported was born of a mother who was irradiated very thoroughly late in pregnancy, the child was apparently normal at birth, but died when ten weeks old.

The severity of the treatment, as well as the period in development when the irradiation was given, no doubt determines the reaction of the fetal tissues. Our third case was treated during the fifth month of pregnancy, and then only locally, an effect largely due to beta ray radiation within the vulval tumor. At the eighth month the mother was treated over the vulva with gamma ray radiation which was equivalent to 50 per cent of the skin dose. The treatment was not severe, the fetus was not directly irradiated, and the child was apparently normal at birth and has remained so to the present time.

"The second division of this study relates to the irradiation of women before conception where complete sterility is not produced. The experimental evidence in the lower animals shows with great probability that irradiation injures the follicular elements of the ovary. The first patient we reported was suffering from Hodgkin's disease and ten months before conception was heavily radiated with x-rays. A male infant was born with an extensive developmental arrest in the formation of the head and died after a few hours. The second patient was irradiated for a fibroid with gamma ray radiation both from within and outside the uterus, and she became pregnant eighteen months later. In this instance a large stillborn infant was born at term. Our last case was also irradiated with a gamma ray radiation from a platinum tube placed in the uterus. Conception occurred seven months later, and the child was apparently normal at birth. Our own evidence is not sufficient to warrant our attributing the developmental defect in the first case, or the stillbirth in the second as due to irradiation.

"Archangelsky irradiated with x-rays ten women suffering from tuberculosis, with the intent of producing abortion, and was successful in seven instances. This evidence is apparently conclusive that irradiation during early pregnancy may produce death and abortion of the fetus. The abortions reported by other clinicians and mentioned above can hardly be considered as additional evidence because we do not know in these cases the condition of the uterine wall or other pathologic conditions.

"It is questionable whether radium or x-ray irradiation should be used to destroy the ripe follicle leaving the immature ones injured but capable of development. This statement is made entirely on the strength of the experimental work on the lower animals and we do not feel justified in considering any of the available clinical records as adding conclusive evidence in this regard. In the treatment of menorrhagia in the child-bearing period we believe that complete sterility is preferable to the possibility of a damaged germ plasm.

"Irradiation of the ovum during early pregnancy should never be permitted. Radiation in late pregnancy, while it may not produce gross abnormalities at birth may hinder the growth and development of the child in later life."

Roentgen Ray Treatment of Skin Diseases. Clyde K. Halsey, M. D., M. Clinics N. America, 6:1155-1164, March 1923.

THE x-ray treatment of skin diseases as carried out at the University of Michigan Hospital during the last three years are here presented. The method is mainly that of the late Dr. Van Zwaluwenburg and differs from the method outlined in Mackee's *X-Ray and Radium Treatment in Diseases of the Skin* in the filter and in the use of a longer spark gap and higher ma. The techniques of Hazen, Witherbee and Reamer have been followed on some dermatoses.

The following lesions are discussed with relation to technique of treatment and to results which may be expected: Superficial malignancies, senile keratoses, acne vulgaris, dermatitis papillaris capillitii, mycelial dermatitis, eczema, favus, sycosis vulgaris, tinea barbae, tinea tonsurans, onychomycosis, verruca vulgaris, verruca plantaris, granuloma fungoides and prefungoid stages of granuloma fungoides, leukemia cutis, hemangioma, lymphangioma, leukoplakia, lupus erythematosus, lupus vulgaris, folliculitis, paronychia, acne rosacea, bromidrosis, hyperidrosis dysidrosis.

Besides these which are specifically discussed the following are named as lesions which have been treated at the hospital: actinomycosis, angioma, blastomycosis, callosity, cheilitis glandularis, clavus, condyloma acuminata, dermititis coccidioides, dermatitis exfoliativa, dermatitis venenata, erythema induratum granuloma annulare, keloid, lichenification, lichen planus, melanotic sarcoma, nevus, onychomycosis, pruritis (general and specific forms), rhinophyma, scrofuloderma, seborrheic dermatitis of face and body, sporotrichosis, tuberculosis verrucosa cutis, verruca seborrheica, verruca vulgaris.

The author concludes by saying: "Roentgen rays, properly applied, are the most useful single therapeutic agent a dermatologist has in the treatment of skin conditions. He issues the warning, however, that extreme care must be exercised in its use. Proper equipment and technique are indispensable to safety, and in no case should treatment extend over six months.

Treatment of Chronic Eczema with Concentrated Carbon Arc Light (Finsen). Svend Lomholt, O. B. E., M. D., Finsen Institute, Copenhagen. Brit. J. Dermat. 35:45-49, February 1923.

X-RAY treatment of chronic eczemas fails completely or partially in some cases, there is always danger of relapse, and repeated treatments not only fail to have the efficacy that the first ones showed but they involve a risk of permanent danger to the skin

Finsen treatment is rather a laborious and expensive form of treatment, says the author, but if x-ray treatment fails to show definite results after the first treatment then the Finsen light should be employed for these lesions. Results with it have proved most remarkable in chronic eczemas as proved by the striking case reports presented here. Relapses may occur but as the repeated applications will do no harm to the skin, treatment may again be employed and cure result. It has the advantage of combining well with all other well known local forms of treatment of this lesion.

Carbon-Arc Light Baths in the Treatment of Lupus Vulgaris. J. H. Sequeria, M.D., F.C.R.P., F. C.R.S., Physician to the Skin Department and Lecturer on Dermatology at the London Hospital. Brit. J. Dermat. 35:93-98, March 1923.

THIS paper reports 70 per cent permanent cures (10 to 20 years); 11 per cent temporarily cured but requiring treatment from time to time for slight recurrences which in most cases finally ceased; 16 per cent benefited but not cured, and about 3 per cent intractable.

The effects produced are intense pigmentation, rapid healing, increase in body weight, improved general condition and in some cases increase in lymphocytes.

The spectrum of carbon light more nearly approaches sunlight than does any other form of illumination and there is no need to inclose the light in an envelope of inviol glass or rock crystal. The Danish government is so satisfied with the efficacy of this form of treatment that it pays for maintenance of patients who take the treatment.

The Treatment of Vascular Nevi with Radium. R. H. Rulison, M. D., and Stafford McLean, M. D. Am. J. Dis. Child. 25:358-370, May 1923.

FROM the standpoint of radium therapy the authors divide vascular nevi into four types: (1) flat angiomas, superficial and level with the skin; (2) flat angiomas level with the skin but deeply infiltrating the cutaneous and mucous layers; (3) angiomas elevated to a greater or less degree with smooth and papillated surface; (4) soft and pulsatile angiomas with fluctuating areas, and (5) erectile angiomatous tumors situated under the skin or in the mucous membrane. Most of the authors' cases came under the third group, some in the fourth and fifth and a few in the second. The type of lesion presented in this study is the raised capillary hemangioma. The patients were infants and young children. The younger the child the better the response to treatment, the authors found.

Radium in the form of 25 to 50 mg. tubes was used, with no filter except the silver capsule container. Distance between tubes and skin varied according to the dosage desired. The tubes were imbedded in dental wax and this was held in place by means of adhesive tape. Dosage was 25 to 200 mg. for from one-half to two hours at a time and if more than one tube was used they were separated by a distance of one centimeter. At least three weeks should intervene between treatments, and a longer period if inflammatory symptoms have not subsided.

In completed cases the average number of treatments was 15; average interval was 24 hrs.; average dosage 40 mg. hrs.; average distance between radium and skin was one-fourth inch. The lesions varied in size from the area of a dime to that of the palm.

The 33 cases here treated are not sufficient in number to justify conclusions as to end results but the general conclusions reached by the study are presented in the following summary by the authors themselves:

"In our experience the disadvantages and advantages of radium in the treatment of these angiomas are these: Radium therapy is expensive and time consuming—both because of the necessity of individual treatments and because of the long intervals between treatments. There is also the chance of overtreatment, with subsequent ulcer formation and very tardy healing. The possibility that telangiectasia and an atrophic skin may result, followed later by kenatosis and epithelioma, has also to be considered.

"The advantages of radium treatment are the freedom from pain, the very gradual changes in the lesion which can be watched from treatment to treatment and the probability of causing the lesion to disappear without appreciable damage to the overlying skin. In addition there is the advantage of rapid healing of ulcerations and hemorrhagic areas, the absence of scarring, under favorable conditions, or when scarring is unavoidable, the production of a smooth, supple, and comparatively inconspicuous scar. It is possible to treat successfully lesions that, because of their location are not suited to other procedures; for example, nevi of the eyelids, or others on account of their depth and extent. Most potent of all reasons for using radium in treating angiomas is the fact that radium exerts a definite, specific, selective action on the abnormal endothelial cells lining the blood vessels which are at fault in the process. Apparently this is not true of any other therapeutic agent at our command.

"Not all angiomas respond equally well to radium treatment. The port wine mark is very obstinate, since flat nevi generally are more refractory than the raised. Many nevi of small size and situated on covered parts are easily destroyed by more rapid methods.

"The scar following the skilful use of carbon dioxid snow is often insignificant. Telangectasia, classed among nevi, is better treated by electrolysis. Surgery often gives brilliant and rapid results.

"In certain selected, raised vascular nevi of the face, radium therapy yields results which cannot be achieved by other methods, especially if the treatment is commenced in early infancy."

The Effect of Radio-Active Radiations and X-Rays on Enzymes—The Effect of Radiations from Radium Emanations on Solutions of Trypsin. Raymond G. Hussey, M. D., and William R. Thompson, M. D., J. General Physiol. 5:647-658, May 1923.

EXPERIMENTS to show the effect of radiations from radium emanation upon aqueous solutions of powdered trypsin yielded the following conclusions:

"It follows that the amount of trypsin decomposed by the radiations from radium emanation depends upon the concentration of trypsin present and is proportional to the quantity of emanation expressed in millicuries and to the time of irradiation expressed in hours. It would seem that it is the active or undissociated trypsin that is affected.

"Evidence has been found which suggests that the beta radiations produce the decomposition observed for which the above statement holds.

"Qualitative evidence has been found which suggests that x-rays, gamma rays and beta rays produce identical effects in dilute trypsin solutions."

Ultra-Violet Energy in Dentistry: Biophysical Studies. By A. J. Pacini, M. D., Director of Biophysical Research, Victor X-Ray Corporation, Chicago. 12mo, 62 pp., 42 illus., Victor X-Ray Corporation, 1923. Cloth.

A clear and concise description of the physics of ultraviolet rays is given with references to the literature upon this subject.

The fundamental principles of ultraviolet application in dentistry are presented together with descriptions of apparatus and directions for technique.

Almost the entire half of the book is given over to the discussion of specific lesions. Each discussion covers the topics of definition, pathologic analysis, therapeutic indications and method of ultraviolet application with a concluding paragraph of general discussion. References to the literature are also given.

The following lesions are thus dealt with: alveolar osteolysis, infectious; abscesses; circumscribed abscess; occlusion of potential infectious locus; periodontal abscess.

Following this is a section dealing with the "Indications for the Use of Ultra-Violet Energy Abnormal Tissue Tone." Here are discussed empyema of the antrum, apicectomy, bacteria (ultraviolet death points for), bleaching, calcification of teeth, caries, cellulitis, degeneration, dentition, endameba, fistula, fracture, gingivitis, hemophilia, hyperemia, Ludwig's angina, mucous membrane, necrosis, osteomyelitis, osteoporosis, analgesic qualities of rays, pulp canal sterilization, and stomatitis.

The book is sent free of charge to physicians and dentists.

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Effect of X-Ray Upon Histology of Nodes in Some Cases of Lymphadenopathy, Found by Adenectomy During Treatment*

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THERE are available many publications dealing with the effect of irradiation upon the clinical phases of sarcoma, leukemia and the pseudoleukemic conditions, and with the behavior of lymphocytes under moderate or massive doses, but there is only a handful of articles in which the anatomical changes in lymphatic tissue are well described. Heineke first emphasized that lymph cells are peculiarly susceptible to roentgen rays but this was after Pusey and Senn had indicated the favorable results obtained in leukemia by treatment with these rays. The really satisfactory literary references begin in 1906 when Warthin published his first observations, followed by several papers, the most important of which are given in the reference list. The observations of this writer have been confirmed and amplified by David and Desplats, Pancoast, Clarke, and Murphy and his associates.

A summary of the work of these authors might be put as follows: Lymphocytes are among the most, if not indeed the most, sensitive cells of the body to x-ray and radium, increasing in numbers under mild doses, decreasing under high doses. These changes may be perceptible almost immediately in circulating lymphocytes but the alterations in the histology of glands are best seen after the lapse of some days, these varying with the intensity of the exposure.

Mild doses playing upon lymphatic tissue cause low grade hyperplasia in chords and follicles while protracted or repeated exposures are followed by a diminution of small mononuclears. After the reduction of the normal adult lymphocytes from repeatedly radiated glandular tissues, larger cells develop resembling the normal lymphoblasts in appearance, which seem to act as lymphoblasts, somewhat resistant to the action of the rays. If radiation of normal nodes be not too prolonged, for example, to the extent of fibrous tissue stimulation, normal architecture and histogenesis will probably return. However, under pathological conditions the altered lymphoblasts continue to make approximately adult cells but the anatomy of the individual is never perfectly normal nor does the histological construction of lymphatic tissue ever return to normal. It would seem that the morbid process is rarely if ever eradicated, and that a node once started on a pathological course never returns to a normal histogenesis and architecture under the action of the rays.

The stage of degeneration in lymphatic tissue is demonstrated by swollen or vacuolated cells, by pyknotic or by fragmented nuclei and by "chromatin dust." Reactive phenomena take the form of an increase of the lymphoblasts noted above, a prominence of endothelial cells and later connective tissue overgrowth; both of the latter two seem stimulated by x-ray directly or by the degeneration products of cellular death. The endothelial cells, because of evidence of phagocytosis in them and because they seem to multiply during treatment, have been thought to participate not only in the removal of cellular debris but actually to effect the destruction of lymphocytes. David and Desplats believe these cells to be very important and that irradiation is effective while they are still active; when fibrosis is excessive and chokes them out of existence the favorable effects of irradiation cease. Connective tissue increase is usually explained as a reparative process as well as one due to stimulation by the rays. In addition to the above changes there may be intravascular endothelial hyperplasia or blood coagulation or both, with the resultant destruction of the lumen of vessels, thereby depriving some sections of tissue of nutrition. When these changes are active it is not difficult to imagine that normal anatomy of lymphatic tissue does not return after x-ray treatment of hyperplasias, tumors or inflammations.

The foregoing summary is from work largely of experimental or necroscopical character and so far as one can learn from the texts is not based upon a study of cases of lymphadenopathy diagnosed with the aid of a bioscopical adenectomy or upon material removed during the course of irradiation treatment. The material upon which the present paper is based came from cases in which a diagnosis was made by clinical history assisted by a pathological report upon the histology of an excised lymph node, the case then treated and a second bioscopical adenectomy performed. The only strictly comparable work in the literature appeared recently from Laignel-Lavastine and Coulaud, who reported a carefully observed and critically analyzed instance of Hodgkin's disease cured (?) by roentgen therapy; they themselves add a question mark. An abstract of their case is as follows: A man of 30 rather rapidly developed numerous hard, isolated, movable glands in neck and axilla with evidences of a mass in the mediastinum. The spleen was not enlarged. Blood counts were within normal limits. The first diagnostic adenectomy revealed a gland, the seat of recent sclerosis in strands especially near the periphery, many polynuclears arranged in small groups, numerous young connective tissue cells, many eosinophiles and a moderate number of very large cells of unusual shape with multiple nuclei, some arranged peripherally. Roentgen ray treatment as described by the authors was given eight times, five hours each, and no area received more than six exposures, the second gland to be excised received ten hours' treatment. This description is not very clear and, if interpreted strict-

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ly, indicates a very massive and protracted exposure; it would at least imply a thorough treatment. Clinically the patient was at first very ill during the treatment, but suddenly, two weeks after the first dose, an improvement began and the patient expressed himself cured. The glands rapidly diminished in size until six weeks later only a few small hard nodes were palpable in the carotid region. At that time a second adenectomy was done. The microscopical section showed the gland to be nearly entirely sclerotic but the connective tissue was so active that it resembled sarcoma. Polynuclears were absent and only a few transitional forms and eosinophiles were present. The very large cells with multiple nuclei were absent. Plasma cells were numerous in the connective tissue areas. The observers would emphasize the advance of the sclerosis and the absence of polynuclears while we wish to call attention to the failure to find in the second gland the large cells usually called Reed cells. Laignel-Lavastine and Coulaud are astonished that such moderate (?) irradiation could have been responsible for so prompt a clinical improvement and for such profound changes in the lymph node. They wisely draw no conclusion that the disease is cured although there was at time of reporting no progression of the process and the patient believed himself cured.

Our own material comprises seven cases, five of which we were permitted to study clinically in the wards of Dr. Alfred Stengel at the University Hospital, while two came from the Presbyterian Hospital in the services of Dr. Talley, Dr. Hamill, Dr. Newcomet and Dr. Fiman. Some of the cases were treated by Dr. H. K. Pancoast who has been kind enough to follow them and to allow us to use his notes and opinions. We wish to express our thanks to all these gentlemen for the permission to use the clinical material.

The periods of clinical observation were of sufficient length in most cases to test the validity of the diagnosis, in others this latter was established at autopsy. Two of the cases are known to be still alive, one was reported doing well a year after discharge while the remaining four are dead; autopsies were obtained of all four.

Case I: This was the case of a white married woman of 25 who was admitted with a diagnosis of Hodgkin's disease of two and one-half years standing. The individuality of this case was that it was in the cellular stage when the first biopsy was performed, that the glands were discrete and did not form large tumefactions in the neck. Some mediastinal growth and a moderate pleural effusion existed. The first gland removed showed the following:

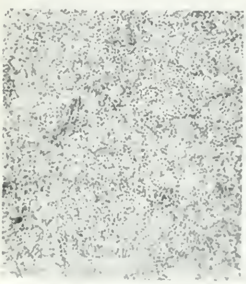
(514) Section shows wide irregular fibrous capsule, the spindly nuclei being mostly adult. Trabeculae wide, adult in middle and young at edges. Along margin of the trabeculae there are numerous small round cells as well as some young connective tissue cells. The marginal sinus is pressed shut, its place being indicated by a few elongated cells and middle sized mononuclears. This also holds for the trabecular sinuses. The follicles as such do not exist but here and there are diffuse groups of small round cells which may have been follicles. Chords are not certainly identified but there are irregular strands of small and middle sized mononuclears, rather irregularly placed through section. Sinuses cannot be identified but irregular groups of middle sized and large mononuclears suggest that sinuses have existed. The section as a whole is made of irregularly arranged groups and columns of cells aforementioned, in the interspaces of which lie a great number of the largest mononuclears with one to four nuclei and a clear nucleolus. There is sufficient space where they are to call it a lacuna. Some of these cells give the impression of phagocytes. There are a very small number of reticulum cells scattered here and there, generally speaking, but there are several areas in which spindly, deeply staining connective tissue nuclei are grouped—beginning fibrosis. Such cells lie in and around small and middle sized mononuclears more than around the larger mononuclears. Fibers, on the other hand, seem to be distributed to trabeculae and their immediate surroundings. Arterioles have very prominent endothelial lining as do venules and some of the former are being compressed to a structure with ringed nuclei. Endothelioid cells are prominent both as free ones lying in lacunae and in blood passages and in what may have been sinuses. Plasma cells are very rare. Mast cells none, eosinophiles very numerous, highly granular and mostly of the polynuclear variety although a few mononuclears are seen. Neutrophiles are moderately common but particularly where the large endothelial cells are not, that is, where small and fibroblastic cells occur. Myeloid cells none. A little fibrin where the fibroblasts are seen. No necroses or tubercular nodes. A very little scattered pigment near trabeculae.

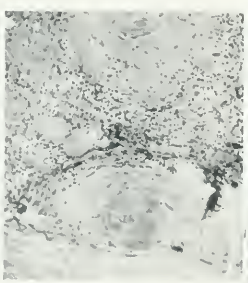
Diagnosis: Hodgkin's Disease of the Reed type without necroses and at the cellular or very early fibrotic stage. (Fig. 1).

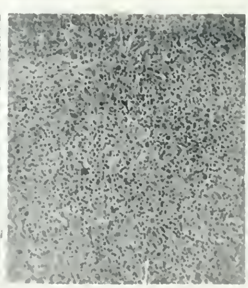
Upon the establishment of this diagnosis radiation treatment was started and during the next thirteen days the patient received one complete series of cross fire, and direct application of radium to thoracic, axillary and inguinal regions. At first the glands enlarged slightly, the skin thickened and a decided febrile reaction was observed. Pleural fluid became embarrassing so that it was removed mechanically only to reaccumulate, but after a second thoracentesis it remained at a minimum. After several exposures a decided improvement began and the patient left the hospital much improved. Reports one year later indicated that under x-ray therapy the improvement had continued. Just before discharge a gland was removed beside the scar of the first adenectomy. Its examination revealed the following:

(535) Gland removed after two weeks of treatment consists of a firm, pale yellow, fairly well outlined homogeneous mass.

Under the microscope it consists of about 80 per cent of hyaline acellular connective tissue which does not give the amyloid reaction. It cannot be recognized as a gland nor can parts such as capsule, trabeculae, follicles and so forth be made out. It does not seem that this connective tissue is especially distributed about blood vessels. Between the coarse strands of the hyaline connective tissue are elliptical, fairly well stained nuclei and some that take the stain less well. The latter seem like connective tissue nuclei, the former lymphoid in nature. Here and there are cellular groups illy outlined from the fibrous tissue which sends strands in among them.







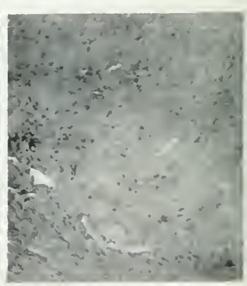


Fig. 1. Case I. A. E. No. 514. Hodgkin's disease in the cellular stage.

Fig. 2. Case I. A. E. No. 535. Section of a gland adjoining No. 514, but after two weeks daily x-ray treatment. Total absence of large mononuclears, fibrous tissue increase, no eosinophiles.

Fig. 3. Case II. P. P. No. 516. First adenectomy. Nonspecific inflammation and hyperplasia of lymph node. Not typical Hodgkin's disease. Numerous large mononuclears, but not so-called Reed type.

Fig. 4. Case II. P. P. No. 544. Section of lymph node adjacent to that shown in No. 516 but after ten days daily x-ray exposures. Absence of large mononuclears. Almost entirely fibroblastic tissue. Rifts indicate position of marginal sinus.

These groups are made up of very well stained small and middle sized lymphoid cells and a moderate number of middle sized mononuclears of vesicular character which seem like swollen reticulum cells. This latter impression is gained especially where cellular areas are looser and have the general structure of lymph sinuses with rather delicate trabeculation. On the whole it would seem as if follicle or chordal areas have been very largely removed, only a few indefinite strands of lymphocytes remaining in and about structures which look like sinuses. Here and there one sees a very large nucleus like the giant Hodgkin's nucleus but compared to the original section they are practically reduced 99 per cent; these are the only endothelioid cells encountered. Here and there are one or two polynuclears. A little brownish pigment is seen in fine granular form both in connective tissue and cellular masses. No plasma, mast, eosinophile, myeloid or true giant cells. No fibrin, necroses or tubercles. Elastic tissue shows in blood vessel walls and a few strands in the capsule. (Fig. 2).

Case II: This case has been reported by us in the Medical Clinics of North American, December 1921, as one of Sternberg's tuberculous pseudoleukemia. The superficial region lymph nodes were never conspicuous whereas evidences of mediastinal and abdominal masses existed all during the course of the disease. With the hope of explaining these lesions a diagnostic adenectomy was performed with the following findings:

(516) Section seems like that from about half of a gland. The major part of the capsule is missing; the remaining part seems to be the cellular internal layer. This layer contains deeply stained cells of the lymphatic series, and a few elongated deeply stained fibroblastic cells. Not many trabeculae are found, those present being rather loose and not followed by sinuses. Marginal sinus is apparently squeezed closed and is not indicated by any definite layer of cells. Where it surely can be recognized it is open. Follicles as such do not exist but here and there are small, rather loose groups of lymphocytes. Chords and sinuses are not easily distinguished. Venous sinuses are indicated in places and surrounded by fairly prominent endothelial cells. Where sinus can be assumed there is a remnant of the reticulum. The hilum is not present so its vessels cannot be definitely described. Large ones present show about normal walls. In them and in the veins the blood shows a predominance of mononuclear cells. One large central vein found distended and surrounded by a very delicate fibrocellular wall. The general gland is made up of an irregularly grouped mass of chord and sinus-like arrangements in which the cells are large, small and middle sized, deeply staining mononuclears with a small amount of cytoplasm. Here and there one will see a large endothelioid cell apparently in a sinus or on the margin thereof. One seen was distinctly phagocytic of cells, granules and red blood cells. A few of these cells have two nuclei, some have a very distinct vesicular nucleus. In the connective tissue and along chords some of the nuclei are vesicular and elongated. One fair sized hemorrhage was seen. Pigment here and there, delicate granules, chiefly free. Few plasma cells, polynuclears a few, and irregularly scattered. No definite granular eosinophiles found. A few large cells seen with distinct oxyphilic protoplasm. Some of the large cells mentioned above have a rather deeply stained nucleus and cytoplasm suggesting myeloid cells more than endothelioid cells; they are not granular, therefore, like promyeloids. Giant cells only of the granular multiple type as mentioned above. In one area there is some advancing fibrosis as indicated by grouping of the connective tissue nuclei. No necroses or tubercular nodes. (Fig. 3).

This seems more like chronic lymphadenitis than anything else but the extinction of the follicles and the appearance of rather numerous large endothelioid cells make a diagnosis of atypical Hodgkin's disease possible although the absence of necroses, eosinophiles, groups of large cells and ringed nuclei speak rather against such a diagnosis.

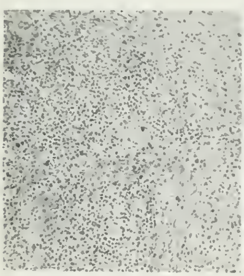
Treatment was begun on the basis of its being Hodgkin's disease, giving in ten days a series of cross fire and surface exposures at multiple points according to H. K. Pancoast's technique but this, instead of helping the patient's condition, appeared to aggravate it, especially the mediastinal mass. A second adenectomy at the expiration of this series, the gland being taken near the site of the first one, revealed the following:

Sharply outlined tough white mass recognizable with difficulty, if at all, as a gland. Section shows a wide, densely fibrous, partly hyalin capsule from which no distinct trabeculae penetrate the mass. It is separate from the internal parts. On the margin of the split, probably the marginal sinus, are a few elongated deeply stained nuclei. The bulk of the mass is made up of adult hyalin connective tissue in the splits of which are a moderate number of small lymphoid cells and of moderate sized vesicular nuclei. Cells probably do not occupy more than one-tenth of the square area. Where they are grouped more abundantly the same kinds of nuclei are seen. The blood vessels are small, well surrounded by hyalin connective tissue. There are also many young capillaries. Very small amount of fine granular pigment near the capsule. Follicles, sinuses, chords not distinguishable. No endothelioid, mast, eosinophile, polynuclear, myeloid or giant cells. Here and there a plasma cell. No fibrin, necroses, or tubercles. Elastic tissue found in blood vessels and a few strands in capsule. (Fig. 4).

Temporary improvement followed the cessation of x-rays but upon resumption relapse was again observed. Autopsy revealed acute miliary tuberculosis of many organs and lymphogranulomatous tumors of lymph nodes, liver and spleen. These latter tumors were of the type described by Sternberg.

Case III: A. P. a Polish boy aged 10 years gave a history of enlarged glands of neck for two years, fluctuating in size both spontaneously and under treatment. For a while they remained limited to one side, but later the other side and axilla became involved. Mediastinal mass was existent but not extensive. Spleen was easily palpable throughout nearly the entire course of observation until very recently. No direct evidence of personal tuberculosis existed, skin tests also being negative, but father and two uncles had this disease. During the year previous to entering the University Hospital a few treatments with x-ray had been given but it was impossible to ascertain the details. No treatments seem to have occurred within the last six months. First adenectomy revealed the following histology:

(556) Section is surrounded by a young fibrocellular capsule which lies almost directly upon a fibrocellular mass not recognizable as lymph node and separated only in a few places by rifts probably remnants of the marginal sinus. Trabeculae are very indefinite since there are so many irregular bands of connective tissue (see below). Follicles as such are not present but there are some indefinite groups of adult lymphocytes, possibly



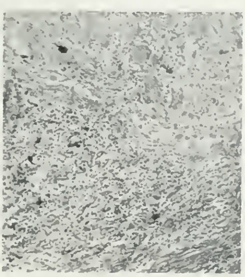
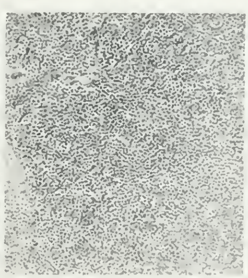


Fig. 5—Case III—A. P. No. 556: First adenectomy. Active Hodgkin's disease of two years standing with fine diffuse fibrosis and moderate eosinophilia. Had a few x-ray exposures several months before this gland was excised.

Fig 6—Case III—A. P. No. 577: Gland adjoining that shown in No. 556 after two weeks daily x-ray treatment. Disappearance of large mononuclears and eosinophiles. Coarse fibrosis not especially perivascular. Small mononuclears somewhat larger and with more protoplasm.



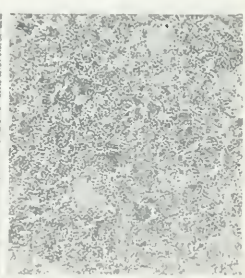


Fig. 7—Case IV S. O. No 552: Adenectomy Uniform hyperplasia of lymph node diagnosed as leukemic hyperplasia. Case aleukemic Cells 7 to 10 microns

Fig 8—Case IV S. O. No 573. Postmortem gland Gland adjoining No. 552 four weeks later, but after ten successive days x-ray treatment and four days of pneumonia. Note appearance of large mononuclears in lacuna and greater vascularity than No. 552 Small mononuclears the same size

the remains thereof. Chords are indistinct, probably made up largely of adult lymphocytes. A few sinuses can be made out with fair distinctness and contain swollen lymphocytes and endothelioid cells with single or multiple nuclei; no reticulum. Hilum vessels are large, walls proper are thin but with considerable connective tissue around them. Internal vessels are numerous, lining cells flat, and fibrous tissue rather hyalin. Connective tissue is everywhere increased. In the cellular areas it is young with a moderate number of small vesicular nuclei but where there is any collection of fibers it immediately becomes hyalin. This hyalin connective tissue really occupies nearly one-third of the general structure of the mass in one section and considerable in the other section. The cellular areas consist of about 67 per cent adult mononuclears and an equal number of swollen mononuclears, swollen reticulum cells, very large endothelioid cells and eosinophiles. The large endothelial cells are of the usual type and in the cellular masses are not in lacunae, whereas in what seems to be sinuses there is a rather definite lacunar space about them. On the whole they are rather well mixed with the swollen reticulum cells and the lymphocytes. Their protoplasm seems rather distinctly acidophilic. Multiple and ringed nuclei are common and some of them are quite deeply stained. Polynuclears are infrequent and single. Eosinophiles are very numerous, particularly in the cell groups. They are mostly mononuclear but there are a few with two equal nuclei. Giant cells only of the Hodgkin's type, not Langhan's, no myelocytes, necroses, tubercles or pigment. Plasma cells moderately numerous in the fibrotic areas.

By polychrome stain practically no granular cells are seen except eosinophiles whose granules are quite small. The very largest cells are divisible into those with a distinct granuloid basophilic protoplasm, thus reminding one of the description of Sternberg, and a rarefied protoplasm with very faint basophilic quality. A few of them show no stain at all. There seem to be gradations in these cells. No mast cells found. A few cells in lacunae seem to have more definite granules but they also seem to be dividing. (Fig. 5).

This case was diagnosed Hodgkin's disease of the fibrous, sclerosing variety with the reservation that in the face of a distinct tuberculous history and certain cellular elements comparable to Sternberg's descriptions, it might be an atypical lymphatic tuberculosis. The boy was treated as if he had Hodgkin's disease, receiving ten daily exposures before a second adenectomy was performed, a gland being removed next to the scar of the first operation. The exposures were as strong as the skin would endure, by cross fire and surface application. This boy has continued under the charge of the roentgenologist for nearly two years, receiving nine series of treatment whenever slight enlargements were noted. He is doing very well. The second adenectomy revealed the following histology:

(577) Much periglandular fibrosis. Mass hard, cuts with resistance, surface streaked with fibrous bands between which is a hard gelatinous substance. No necroses or hemorrhages. Section shows an extremely wide hyalin capsule and the section area consists of practically 75 per cent of hyalin connective tissue. Cells are almost exclusively of the lymphoid type but are separated by fine fibrosis. There are a few swollen reticulum nuclei, and one endothelioid cell was found, having, as in 556, a tendency to acidophilic staining of its cytoplasm. A few plasma cells seen, no mast, eosinophile, neutrophile, myeloid or giant cells. No fibrin, necrosis, tubercles or pigment.

Stain for elastic tissue shows it in blood vessel walls, in the capsule, and the coarser trabeculae; not in the fine fibrous tissue.

Fibrous tissue stain, Van Gieson, shows it dense and hyalin both in coarse and fine areas. (Fig. 6).

Case IV: This patient, a man of 60, had had isolated, firm, painless nodules in neck for a year and a half with the more recent development of similar masses in the axillae and groins. This case was reported by us in the American Journal of Medical Sciences for March, 1922, as an example of aleukemic leukemia or systemic lymphomatosis. The peculiarities in this case were the fluctuation in size of the cervical glands when treatment was started for diseased tonsils and carious teeth, the apparent general well-being of the man throughout most of his illness (although toward the time he was admitted some failure of general health was observed) and the absence of enlargement of the mediastinal glands and of the spleen. Throughout the whole course of observation the leukocyte count was very low, 6,500 being the maximum. During the x-ray treatment these cells dropped to 3,300 per cubic millimeter. Nor did they rise during the terminal pneumonia. Hodgkin's disease was the first diagnosis but this was corrected by the study of an excised gland.

(552) Gland from neck about 2.5 by 2 cm. Smooth, pale pink capsule which is thin and uniform on section. Mass is pale gray-pink, homogeneous, soft, not traversed by fibrous bands. Section consists of rather uniformly staining mass fairly well outlined by delicate capsule, outside of and within the splits of which are cellular infiltrates. The marginal sinus cannot be recognized. Node seems to be of a single type of cell separated by a few delicate connective tissue strands carrying blood vessels and cut at different angles. The cells vary from 7 to 11 microns, the nuclei from 5 to 9. The nuclei are fairly well stained, have a clear but delicate nuclear net work. The protoplasm is neutrophilic with here and there a slightly oxyphilic example. They are mostly round or elliptical but some compressed ones are seen. Here and there one will see what seems to be a true young connective tissue nucleus. By Van Gieson's stain the capsule and delicate septa show clearly but there are no fibers between the cells. A polychrome stain (only fairly satisfactory) shows no true granules of the myeloid type but here and there one finds pictures like azure granules. By this stain a polynuclear eosinophile was seen and large mononuclears of large endotheliocyte proportions were found and these have distinct vesicular nuclei and a purple cytoplasm, very distinct from the scanty neutrophilic protoplasm of the average cell of the section. One eosinophilic mononuclear was found. Schridde stain reveals no real perinuclear granules and here and there one sees masses of irregularly staining and granulated appearance and also masses or matter which might correspond to the above mentioned azure granules. Section showed no oxidase granules by Graham's method. (Fig. 7).

Roentgen ray treatment was given in one complete series over all bones and the neck for a period of twelve days. Exposure to cold and draught during one of the last trips to the x-ray laboratory resulted in a pneumonia from which the man died in four days. At autopsy a gland was

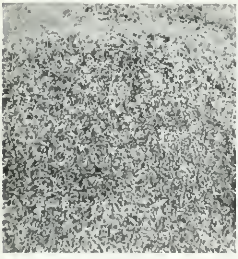
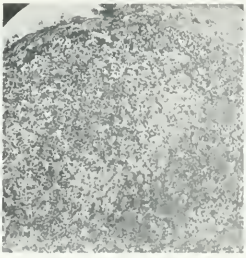
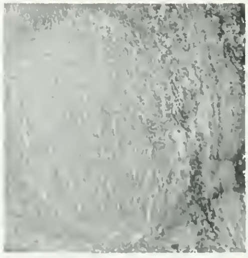
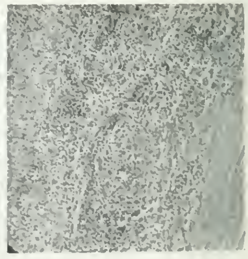





Fig 9—Case V—S G No. 592 First adenectomy. Section of lymph node in a case of mycosis fungoides or of cutaneous leukemia. Solid lymphoid hyperplasia with a very few small lightly stained reticulum cells.

Fig 10—Case V—S G No. 631: Second adenectomy. Section of lymph node in same case as No. 592 after three weeks x-ray treatment run in a series over the entire body. Lymph cells same type as No. 592, but much greater prominence of the lightly stained cells.

Fig 11—Case VI—P P Dr Talley et al, Presbyterian Hospital. Lymphadenopathy of rather short duration as discrete masses in neck and axillae. Principal type of cell like young lymphocyte about nine microns. Partly successful attempt at restoration of lymph gland architecture. Most like a leukemic hyperplasia of lymph nodes.

Fig 12—Case VI—P P Dr Talley et al, Presbyterian Hospital. Second adenectomy after nine months intermittent roentgenotherapy. Destruction of all architecture, increase of coarse fibroses, no fine intercellular fibrosis. Tissue to be looked upon as a leukemic hyperplasia affected by x-ray or as reticulum [illegible].

removed from beside the scar of the diagnostic adenectomy. The autopsy revealed leukemic hyperplasia of all lymph nodes including a large tumorous swelling of the retroperitoneal group and of the spleen, and an infiltration of the liver; the cause of death was a fibrinous pneumonia and early plastic pleuritis. The gland removed at autopsy revealed the following:

(573) After x-ray small, soft, rather doughy, well encapsulated homogeneous deep pink gland, section surface of which swells. Fairly well outlined mass. Not recognizable as lymph node. Connective tissue around it is hyalin and fairly well delimitated from the cellular mass. The mass consists almost exclusively of cells of the small lymphoid type with barely visible protoplasm. They are irregularly arranged but fairly solid. In the interstices are large numbers of singly disposed endothelioid cells. Fibroblasts are not visible, capillaries are very numerous, their walls being made of flat endothelia and a small amount of fibrous tissue. The mass resembles the original gland in its solid state but the principle cells are smaller and the numerous endothelia in lacunae present a new feature. There is no fibrosis. (Fig. 8).

Case V was one upon which some uncertainty existed as to exact terminology but it surely belongs in the groups usually called granuloma fungoides or leukemia cutis. A male Italian of 42 gave a history of pruritis of six years standing. Over the areas in which this had existed for some eight months the skin became dry, scaly and fissured. Three months before the present treatment, separate painless enlargements of lymph nodes were observed in the inguinal regions. Examination of the man reveals a dusky red, fissured, exceedingly dry skin, covered with scales except on the palms and soles. Discrete glands were found in the neck, axilla and groins and some under skin of the trunk, spleen is much enlarged. Leukocytes on admission were 25,000 of which 43 per cent were polynuclears, 52 per cent small lymphocytes, 3 per cent large mononuclears and 2 per cent eosinophiles. The total count later rose to 30,500 with 60 per cent of small mononuclears and 30 per cent of polynuclears; there was, therefore, a low grade mononucleosis or sublymphemic state. A diagnostic adenectomy coincidently with this blood count showed the following:

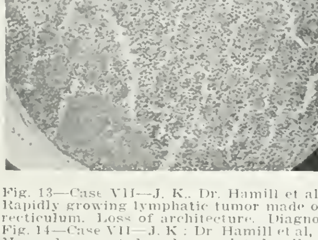
(592) Section of tissue well encapsulated by a narrow but adult connective tissue capsule. The general architecture like that of lymph node but all cellular features are exaggerated. Marginal sinus for the most part is open but in some places crowded with small lymphocytes. The trabeculae are adult fibrous tissue containing in places many mononuclears and a few polynuclears. The gland is made up of follicular and chord-like groups of lymph cells between which there are single, grouped and strand-like sections of very large mononuclears of the endothelial type. Some follicles are solidly lymphoid. Others contain a very large germ center in which, however, there is about an even mixture of large and small mononuclears. Chords are solidly lymphoid. The sinus linings cannot be made out clearly because these spaces are crowded with large and small mononuclears and melt into the edge of the chords. Reticulum both in sinuses and between the cells is very scanty. Lymphocytes are nearly all adult. Reticulum cells inconspicuous but nuclei larger than normal. Endothelioid cells quite prominent along the edge of chords and in sinuses but marked in follicular or chordal areas. Plasma cells few. Mast cells and eosinophiles absent. Polynuclears, moderate number especially along trabeculae. No giant cells and few large multinuclear cells with pale nuclei. No fibrin, necrosis, tubercles or pigment. Vessels around capsules quite large and contain many leucocytes almost entirely of the mononuclear variety. Leukemic hyperplasia of lymph node. (Fig. 9).

A piece of skin removed at the same time showed lesions similar to those described for leukemia cutis. The patient was treated by x-ray receiving in twenty-three days two series of one-third the usual leukemia dose over entire body. A week after the last exposure another gland was removed. During treatment at the University Hospital a noticeable reduction occurred in the size of the spleen and regional nodes and the pruritis and redness were much improved. He was then discharged because of misconduct, but has since been in charge of other roentgenological laboratories.

(634) Lymph node from abdominal wall after one-third erythema dose six days, interval eleven days and again six days of x-ray treatment, based on diagnosis of cutaneous leucemia or mycosis fungoides. Section looks like solid lymph node but division into marginal and medullary areas not clear. Capsule is adult fibrous, in places becoming hyalin. Marginal sinus is for the most part pressed shut but can be seen here and there as a rift without cells or reticulum. Trabeculae small, delicate, adult. Follicles consist of a narrow rim of small mononuclears and a large central area of middle sized mononuclears smaller than the average endothelioid cell, a few eosinophiles, no central vessel. The mass of the gland is made up of irregularly disposed lymphoid tissue in which sinuses and chords are not distinct from one another. The parts which might be called chords are solidly lymphoid, with a few quite large mononuclears and a rather coarse reticulum. Scattered in this lymphoid tissue are mononuclears mostly single, a few in groups not unlike the cells of 573. Here and there small areas of pale staining may be found as if the cells at this point were dying. There is, however, no pyknosis or karyorrhexis. Some of these areas are in follicular centers. Reticulum cells inconspicuous. Lymphocytes all adult, a very few plasma cells and eosinophiles. No mast, myeloid, giant cells, fibrin, necrosis, or tubercles. Small amount of golden brown pigment in the looser areas suggestive of sinuses. Blood vessels few, small arterioles. Lymphatic hyperplasis of lymph node. (Fig. 10).

Case VI is the first to be received from Dr. Talley, Dr. Newcomet and Dr. Eiman of the Presbyterian Hospital. A male of early middle life was admitted with discrete glands in neck and axilla ranging from a very small size to that of a hen's egg. Spleen very slightly increased in size. No change in mediastinum. A diagnosis of Hodgkin's disease was made but this could not be confirmed by the results of a diagnostic adenectomy which were as follows:

(5655) Section consists of tissue which can be recognized as a lymph node because of the fibrous capsule and trabeculae, and an attempt to retain follicle markings. Capsule is wide, fibrous, as are the trabeculae. In places a marginal sinus can be made out containing small mononucleas and red cells. Follicles are large accumulations of large sized small mononuclears of about uniform diameter without a tightly packed marginal zone. By reason of this enormous increase of follicular size, chords are not clear although suggested between nearby follicles. Sinuses are pressed shut and where they can be made out seem lacking in reticulum. The fine reticulum in follicles and chords is difficult to detect. A few endothelioid cells are present here and there in the follicles, and suggest swollen reticulum cells. The lymphocytes are of the type classed as young and measure about nine microns. Here and there some cells suggest the plasma type, but this is rare. No eosinophiles or myeloid cells, giant cells,



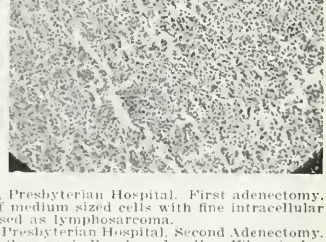


Fig. 13—Case VII—J. K., Dr. Hamill et al, Presbyterian Hospital. First adenectomy. Rapidly growing lymphatic tumor made of medium sized cells with fine intracellular recticulum. Loss of architecture. Diagnosed as lymphosarcoma.
Fig. 14—Case VII—J. K : Dr Hamill et al, Presbyterian Hospital. Second Adenectomy. Many degenerated and vacuolated cells. Some spindle shaped cells. Fibrosis between cells and in coarse strands increased. This was removed after two series of x-ray treatments directed to the area from which the gland was removed.

fibrin, necrosis, tubercles or pigment. (Fig. 11). This is, according to our classification, a leukemic hyperplasia.

Roentgen ray treatment was carried out by giving 13 series during nine months, of which seven directly reached the area from which the second gland was removed. The tumors receded in size in axillae and neck but those in chest and abdomen (which developed during the nine months) did not respond to radiation. Dr. Newcomet thought that this was sarcoma because of the reduction of size of tumors directly rayed. Condition becoming worse by reason of symptoms of nervous system involvement, patient was readmitted to hospital and another gland removed. At this time separate small tumors could be detected all over body especially in the left lower abdomen, but not in mediastinum(?). Blood counts were within normal limits except that polynuclears were relatively low. Autopsy by Dr. Eiman is reported as follows:

Lymphosarcoma primary in neck, metastases to mediastinum, pleura, retroperitoneal region, pelvis, mesenteric glands, liver, lungs, spleen, R. adrenal, L. kidney; producing obstruction to thoracic duct and R. ureter; chronic parenchymatous myocarditis with dilatation; atrophy of R. adrenal; R. hydroureter, hemorrhagic cystitis, chylous effusion in both pleural sacs and in peritoneal space. The important individual features of the autopsy were as follows: No skin lesions. Apparently principal tumor was in neck. Mesenteric and pelvic glands involved in large mass. Individual masses in liver. Diffuse infiltrate in spleen. No apparent involvement of spinal chord. Glands as a rule were discrete. No degenerations.

The second gland to be removed gave the following result to histological study:

(6300) Section consists of a mass of cellular tissue traversed by fibrous bands, the whole not being recognizable as a lymph node. On one side is some condensation of fibrous tissue which may have been a capsule but its strands are here and there separated by cellular infiltrations. The main mass of this section consists of regularly dispersed cells with here and there a small blood vessel which acts as a sort of incomplete septum. Between the cells no fibers are perceptible in the hematoxylin and eosin stain. The cells of this tissue are very mixed, and it is difficult to state which type, if any, predominates. There are small deeply staining lymphocytes and there are larger cells of similar character and a few plasma cells. There are many large deeply staining nuclei with abundant protoplasm. There are polygonal cells. There are a few multinucleated cells but practically no polynuclears, eosinophiles or giant cells. The fibrous strands which pass irregularly through the outer parts of this tissue are wide adult fibrous tissue, in some places hyalin. The small amount of connective tissue that may be seen near blood vessels within the main cellular mass is also adult and may be hyalin. (Fig. 12).

A very satisfying explanation and nomenclature of this second gland is not easy to obtain. At first sight it would seem like a reticulum sarcoma because of the absence of an intracellular fibrosis (then indicating that the first gland did not represent what the second gland did or that the whole process had changed) but it may be on the other hand merely a modification of the original leukemic hyperplasia under the influence of radiation. The case surely progressed as though it were sarcoma and the pathologist believed that an original sarcomatous tumor was localized in the neck.

Case VII was another case from the Presbyterian Hospital, under the care of Dr. Hamill, Dr. Newcomet and Dr. Eiman. It was a boy of six who had suffered for only two weeks before admission, however, with enlarged cervical glands; these had followed pain in the chest of two weeks duration. Glands were found in all parts of the body as discrete, soft, movable, painless masses. Spleen was enlarged but not so the liver. Mediastinum contained a definite mass. First diagnostic adenectomy showed the following:

(8088) Section consists of cellular mass surrounded by a very delicate capsule. It resembles hyperplastic lymph node, but cannot be certainly identified as the same. The finely fibrillar capsule lies directly upon the cellular masses. No trabeculae. Follicles are suggested by very large groups of mononuclears, of about nine microns, separated from one another by condensed strands of cells of the same type. The nuclei are not deeply stained and show a rather indistinct chromatin net work. Between the cells in all positions is a delicate reticulum. Chords and sinuses not certainly distinguished. Vessels are few and have thin walls. The hilum is slightly fibrotic. A very small number of swollen reticulum nuclei are found. A small hemorrhage was found and a few scattered granules of pigment. No other varieties of cells discoverd.

This seems like a well advanced leukemic hyperplasia, but the persistance of a fine reticulum, and its apparent increase suggests that the condition approaches lymphosarcoma; there is, however, rather too much retention of the architecture to make this latter diagnosis absolute. (Fig. 13).

Because of the suggestion of sarcoma of lymphatic tissue, Coley's fluid and x-ray were used. Neither had much effect and death took place five months from the first signs. There was during the course of the case a moderate anemia and a leukocyte count varying from 9,600 to 13,000 but with a very uncertain differential picture; at no time was the differential count indicative of leukemia. The irradiation treatment was in five series during five weeks, of which four antedated the second adenectomy and two played directly upon its area. The treatment was not satisfactory and no distinct improvement in size of glands or general condition resulted. The second gland removed revealed the following under the microscope:

(8209) Section cannot be recognized as lymph node. Capsule definite adult fibrous tissue, hyalin in places with considerable adult fibrosis in trabeculae and at the region which might be the hilum. The rest of the tissue consists of a mixture of two types of cells separated by some connective tissue, fibe in rather coarse strands when viewed und the high power. These two types of cells a as follows: A roughly round cell with deepl staining, round nucleus and a generous suppl of acid-staining protoplasm; some of the cells seem vacuolated. The other type of cell elongated with a rather indistinct nucleus ru ning longitudinally to the cell and of the sam shape. These cells tend to run in strand Here and there small blood vessels may b seen some of which are obliterated. (Fig. 14)

This tissue like the second specime from Case VI is difficult to name bu it seems like a sarcoma affected by th rays in that fibrosis has increased an certain cells have degenerated whil others are being stimulated into activ ity.

The autopsy done by Dr. Eima was noted as showing sarcomatosis Its peculiar features were:

Discrete enlargements of lymph node Notes indicate that enlargements in media tinum and abdomen are of discrete but adhe ent glands except in mesentery which is large confluent mass. Section surface sof bulges, homogeneous, yellow-white, no ne croses. In liver discrete nodules and wha seem to be infiltrates. Spleen almost replace by confluent nodules. Infiltration in lungs.

SUMMARY

There are recorded in this articl the outlines of seven cases of lymph adenopathy composed of the followin diagnoses: One case of Hodgkin' disease in the cellular stage, one cas diagnosed as Sternberg's pseudo-leu kemic tuberculosis, one case with grea similarity to this last disease bu classed as sclerosing Hodgkin's dis ease, a case of aleukemic leukemia o systemic lymphomatosis, a case of leu kemia cutis with sublymphemic blood one of aleukemic leukemia or reticu lum sarcoma and one of lymphosar coma. These diagnoses are made o the basis of a classification used b Dr. Farley and myself and now i press (Am. J. Med. Sci.). The pres ent work was not undertaken as support for this classification but natur ally it was hoped that additional cri teria would help to confirm the cor rectness of the system on which i was based. This has been achieve only to an extent consistent with pre viously recognized classifications, i reference to the separation of th Hodgkin's and allied diseases from aleukemic leukemia and the decide difference between the leukemic hyper plasias and those of a more neoplasti nature.

The figures are photographs of th best fields obtainable to represent th majority of the principal characters o the sections. They were taken wit the same machine, and excepting case VI and VII, with the same magni fication; these two are a very littl lower in enlargement because repre sentative fields did not remain clea for both slides of each under th higher power. The magnifications ar

close enough to be comparable throughout.

Strict comparison of the effect of x-ray cannot be made throughout the seven cases because of the different durations of the individual instances, the character of treatment it was possible to administer and the length of such treatment. The seven cases, however, fall into three groups about which some general observations are permissible. The effects of irradiation as summarized on an earlier page are confirmed by these cases. The lymph cell and its congeners are definitely reduced while the endothelial and fibrous tissue cells instead of being limited in production, seem definitely stimulated to multiplication. It is also very certainly demonstrated that there is no return to normal architecture in glands under the action of x-ray and radium. There is greater evidence of phagocytosis by large cells with vesicular nuclei in tissues that have been rayed than in those removed before treatment.

The first group that can be made from our cases includes numbers I, II and III, instances of lymphogranuloma, one a distinct Hodgkin's disease and two suggestive of a tuberculous origin. Under the influence of x-ray and radium the degree of fibrosis is the most conspicuous feature but the practical disappearance of large endothelioid and Reed cells is certainly definite. The fibrosis appears in strands and in what were possibly follicular areas, not necessarily perivascular, although sometimes around vessels, but more in places where one would expect to find numerous elongated, swollen, elliptical nuclei. The lymph cells of adult proportions disappeared almost entirely in Cases II and III while in number I they remained in small groups or scattered singly. In Case III large forms approaching lymphoblastic proportion were to be seen. The reaction as a whole resembles somewhat the coarse and deforming fibrosis to be seen in late stages of tumor-forming Hodgkin's disease and might be described as an accelerated natural course of events. Since no return to normal occurs and an unnatural gland is still existent, we cannot forbear to comment that perhaps the wisest course in all cases of Hodgkin's disease is to remove surgically all accessible tumor tissue.

The second group includes Cases IV and V, which although differing radically in a clinical sense present tissue with many similarities both before and after x-ray treatment. Their principal resemblance consists of the uniformity with which the lymph cell is the dominant feature of the hyperplasia. Neither case was frankly leukemic from a clinical standpoint although No. V was suggestively sublymphemic for a time. The effect of the treatment given those two patients was to reduce the number of small mononuclears in the lymph nodes but there was no essential change in the anatomy of the individual cells. More striking, however, is the greater visibility of the large mononuclear cells after x-ray. (Contrast Figs. 7 and 8, 9 and 10). It is believed that these cells are actually increased in number but it may be that it is a reduction of the small cells which makes them more conspicuous. An attempt at counting them in comparable fields was not satisfactory although more were counted in the treated gland. Vascularity is greater after treatment. Fibrosis, however, is not at all a prominent feature of the microscopical sections of these particular glands; even fine perivascular, intercellular and capsular connective tissue increase is missing.

The last two cases fall together in some respects and are radically different in others. To our view Case VI has some resemblance to Case IV but was of course a much more rapidly progressive disease. Because of the early attempts at the retention of nodal architecture we place it in or near the leukemic hyperplasias, although it must be admitted that in gross pathological behavior the disease bore some resemblance to sarcoma. The effect of longer development of the process and of x-ray treatment was to destroy all normal relations, to induce a coarse fibrosis and to change the type of cell to one of irregular proportions and staining properties and to make some of them degenerate.

Case VII was certainly of rapid sarcoma-like character. In this instance the primarily nearly homogeneous cellular picture was changed by x-ray into one in which degenerated cells were mixed with actively growing individuals resembling spindly sarcoma elements and the fibrosis was increased in strands and between units.

It may be added at this point that obliterative thrombosis so commonly described as one of the effects of radiotherapy was not a notable occurrence in any of our sections. Indeed in Cases IV and V there seemed to be a larger number of small vessels after than before the treatment.

We do not wish to draw final conclusions upon the action of roentgen rays on lymphadenopathies from these seven observations. This is, however, a considerable amount of material, since reasons for repeated adenectomy are not often at hand. We would, however, draw concluding attention to certain features which have stood out prominently in our material. The first of these is the character of fibroses in lymphogranuloma and the disappearance of the large endothelioid cells in this process. The swollen reticulum and endothelioid cells of the leukemic hyperplasias as illustrated by Cases IV and V, are not reduced, but made more visible, possibly by increase in number. The anatomy of the lymphocytes in these two cases was not appreciably altered by x-ray but their number was reduced. In the lesions suggesting sarcoma as in Cases VI and VII where endothelioid cells do not appear prominently in the original picture they do not become more visible with x-ray treatment. The principal cells of these tumor-like cases are greatly changed under x-ray both in arrangement and individual character. Fibrosis in the lympho-granulomatous varieties is much more voluminous than in the leukemic and neoplastic. Fibrosis does not seem to increase between the cells after treatment when it has not been present in this location before radiation. The statement made by other writers and repeated in an earlier paragraph that normal architecture does not return in an abnormal lymph node under the action of roentgen rays is fully confirmed by the descriptions and photographs.

The bearing that these findings have upon the classification from which the diagnostic names were taken is simple and limited. The lymphogranulomatous processes, whether truly tuberculous or of the Hodgkin's variety, belong together and their reaction to x-ray is distinctly different from that of the leukemic and neoplastic hyperplasias. Between the latter two there are also essential differences notably in the behavior of large endothelioid cells but the particulate elements of neoplastic hyperplasias are much more susceptible to change of anatomy than are those of the leukemic growths. Tumor cells degenerate readily and completely alter their shape, while lymphoblastic cells retain nearly normal proportions and may vary little or none in staining qualities. The reasons given in these last few sentences may offer further criteria for a systematic classification.

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The Value of Oblique Films in the Study of the Thorax*

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THE posterior thoracic territory with its borders and contents does not receive the same degree of study as the more accessible parts of the chest. The fact that the posterior mediastinum is more difficult to visualize and that abnormalities occur with less frequence in this secluded field may account in some measure for the neglect.

Anterior stereoscopic impressions fail to reveal that extensive thoracic area which contains the mediastinal spaces and contents. During the past eight years it has been our rule to combine the fluoroscopic and posteroanterior stereoscopic studies with that of the physical examination and clinical evidence before giving an opinion on the condition of the thoracic contents. Recently it was realized that the above method of examination left many cases of thoracic disturbances unexplained. This led to a more frequent use of the oblique film in order to visualize the posterior mediastinum.

Our appreciation of the value of exposing the oblique plane of the thorax is due to the work of Evans, of Detroit, in which he demonstrated the importance of this method in the diagnosis of tracheal bronchial adenopathy in children. In his series it was not uncommon to find children with lung roots which appeared practically normal when studied in the anterior dimension, but which showed signs of frank enlargement of the posterior bronchial glands when the oblique films were examined. This observation led us to adopt as a routine procedure the use of oblique chest films in all radiographic studies of children.

Pfahler has helped us in demonstrating the value of this method in locating and estimating the extent of substernal goiters, while in the routine examination of the esophagus and dorsal spine the method is universally employed. European observers, especially Vaquez, have also called attention to the good results obtained by the study of the oblique diameter of the thorax. Yet this plane is seldom investigated unless some abnormality in the anterior observation suggests an oblique view or some important evidence found in the patient's history stimulates further search for an etiological factor. We feel, therefore, if a chest is worthy of x-ray study, that such study should include a film of the oblique plane as a routine measure, and that the adoption of such a method would reveal many frank abnormalities hitherto unsuspected. This is particularly true of the arch and descending portion of the aorta.

What constitutes x-ray evidence of a pathological aorta? Some observers feel that a distinctly outlined aortic shadow on oblique position must be considered as abnormal. This may be worthy of consideration when only the screen is used, but aortic impressions recorded by radiographic oblique films are, in our opinion, not necessarily a sign of abnormality or disease. Was it not considered, at one time in the recent past, that a definite outline of the kidney was evidence of disease? Now failure to secure a frank density is considered a sign of poor technique. More recently the visualized gall-bladder has been accepted by many radiologists as a distinct sign of pathology. Is it not true that other keen students in interpretation disagree with such a view, attributing the definite outline of the biliary reservoir to proficiency on the part of the technician? In our earlier experience we were inclined to consider a shadow formed by the descending portion of the arch as a sign of atheroma, whether or not calcareous deposits were discernible. The finding of many cases in which a uniform, evenly distributed image of the aorta was seen, especially in some healthy children, led to modification of this view.

Irregularities in shadow density, we think, should be taken as more definite evidence of the abnormal. Before the thoracic aorta can be considered pathological, careful consideration must be given to the age, weight, height and build of the patient. The normal arch curve in the oblique position varies under these circumstances. The intensity of shadow would naturally increase with the age of the subject. After all is considered, it is difficult to estimate size, width, or density by definite measurements. Orthodiagramatic oblique plates are some times of use in obtaining a more accurate estimation of the size of the aorta, but this procedure takes time and in only a few instances is it worth the effort. The presence or absence of pathology in the aorta must be estimated by signs of distinct departure from a reasonable normal. The estimation of what constitutes normal and abnormal must be decided by the radiologist whose duty it settle such questions in clinical x-ra

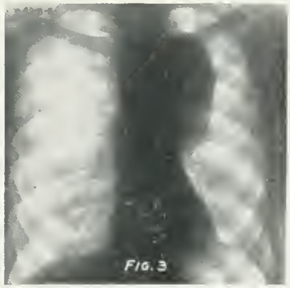
Oblique plates are indispensab the study of mediastinal tumors, di or enlargement of the glands (chial, thyroid or thymus) or the tion of foreign bodies in the bro Many observers feel that a fluoros study is sufficient and that su method has the additional adva of detecting the presence or absen pulsations, thereby differentiatin some extent between circulatory normalities and tumors. Our exper has convinced us that both proce are necessary. The oblique film reveal delicate destructions and b aries which the screen in turn to distinguish. Pulsations in mass tumors may be transmitted from cent circulatory tissue and tend to fusion. The permanent record o film for continued study and comparison is further proof that the film and the screen are nece in investigating the posterior po of the thorax. The inclusion of o films as part of the routine radiogr study of the thorax in about eight dred cases examined during the few months led to the belief tha procedure should form a part thorough observations of the thora contents.

The technique is simple; a oblique can easily be obtained by ing the right chest to the film, b angle must be accurately caug allow little or no sign of the pulm tissue to be seen on the opposite s the spine. A preliminary screen is often necessary to get the exact Special measuring devices have invented, but we have found littl culty in estimating the proper p in which to place the patient.

The following cases illustrat importance of permanent obliqu pressions of the thoracic cavity:

Case I: Mrs. S., aged 68, h joyed good health until three year when she began having a sligh ductive cough, accompanied b casional wheezing dyspnea and su tion. During the summer months symptoms subsided. For the past however, there has been a per pain in the back of the neck ar interscapular region, accompanied definite numbness in the lower The patient is nervous and com of a light feeling under the ste There are no signs of tenderness interscapular area.

*—Read at the Annual Meeting of the Radiololgical Society of North America, Detroit, December 7, 1922.



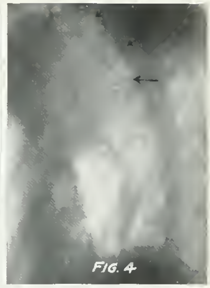


Fig. 1—No cardiac hypertrophy. Aortic arch apparently only moderately enlarged for patient of 68 years of age.

Fig. 2—Shows an oblique view of Figure 1. A very definite aneurismal enlargement of the descending aorta.

Fig. 3—A very extensive aneurism of the arch and upper thoracic aorta.

Fig. 4—An oblique view of Figure 3, showing atrophy of the bodies of the third and fourth dorsal vertebrae from persistent pressure of the aneurismal sac.

The physical examination shows no definite abnormality. Nutrition and development are good, considering the patient's age. Blood Wassermann, negative. Recent mucopurulent expectoration showed no acid-fast bacilli.

In the stereoradiograms (Fig. 1) each pulmonary base showed indistinct, hazy markings characteristic of a chronic venous congestion. No cardiac enlargement was found and the aortic arch was not definitely widened. The right oblique film of the thorax (Fig. 2) showed a round bulging enlargement of the lower thoracic aorta, characteristic of an aneurysm. The bronchitis and dypsnea could thus be easily explained. The posterior-anterior stereoradiograms did not show any abnormality, while the fluoroscope showed only an ill-defined mass in the posterior mediastinum.

Case II: Mr. L., aged 62, for the past six months has complained of pain in the back, localilzed in the interscapular region. This has been associated with a loss of 25 pounds in weight and a definite persistent cough with watery, mucoid expectoration. In the latter no tubercle bacilli were found. Blood Wassermann, four plus.

The stereographic film (Fig. 3) shows no cardiac enlargement, but the upper portion of the aorta, including the arch, forms a huge rounded dilatation with the definite earmarks of an aneurysm. The right oblique film (Fig. 4) shows this large aneurysm to be limited to the upper half of the thoracic aorta, but it also shows a distinct atrophy of the bodies of the third and fourth dorsal vertebrae from the persistent pressure of the aneurysmal sac. In this case the oblique film of the thorax was necessary to find the osseous atrophy, and thus the probable cause of the interscapular pain was found.

Case III: H. R., female child of 12 years (Fig. 5). Previous history: pneumonia at five months, measles, mumps, whooping cough and chickenpox in childhood. At present ten pounds under weight A right oblique film of the chest shows a definite aortic shadow which if pathological is unusual at this age.

Case IV: Mr. F., anterior chest stereoscopic films show a moderate enlargement of the lung root zones, while the oblique (Fig. 6) brings into view a clean cut nest of hypertrophied glandular tissue in all probability accounting for the cause of a chronic persistent non-productive cough, heretofore unaccounted for.

Fig. 5—Right oblique view of the thorax in the case of a child of 12 years of age. Note the definite shadow caused by the aortic arch.

Fig. 6—An oblique view revealing hypertrophied glandular tissue in the posterior mediastinum. The anterior view in this case revealed no abnormality.

The Roentgen Analysis of the Right Diaphragm*

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MY ATTENTION has been attracted to this subject through the demand of clinicians for information upon lesions with obscure or overlapping clinical signs of disease at, above or below the diaphragm upon the right side. The right diaphragm seems to present more clinical demands but less difficulty in diagnostic radiological analysis. The diaphragm is a true border-line between the thorax and the abdomen.

The confusion of symptoms and clinical evidence at the right diaphragm is as truly a border-line condition as ever existed at political border-lines. Parenthetically, one might engage in an imaginative synchronistic politico-pathologic analogy of the subject. As this analysis proceeds, imagine—if you please—that the diaphragm is the Mason and Dixon Line with the solid hepatic South below; the free-breathing pulmonary North above, airing its opinions to the stolid South steeped in its own comfortable slavistic torpidity. Between them the well-defined line of demarcation, a political diaphragm. Naturally those people in direct contact to this border-line must be in constant turmoil, political congestion and border-warfare. John Brown at Harper's Ferry with his underground tunnel is the lymphatic pathway of exchange. Enough of this personality of disease. One must engage your serious attention to cold scientific facts—if such there be.

This analysis of the right diaphragm: radiologically speaking, offers the following points of interest:

1. The Normal Diaphragm:
   Anatomy, shadow contour, excursion.
2. The Pathologic Diaphragm:
   Contours, movement, excursion, variation, thymic equation.
3. The Concomitant Movement of the Lower Ribs.
4. Specific Pathologic Conditions:
   Diaphramatic Hernia
   Eventration
   Paralysis.
5. Sub-Diaphramatic Pathologic Condition:
   a. Sub-phrenic abscess.
   b. Hepatic abscess, tumor, cyst.
   c. Abdominal ascites, leukemia, ovarian cyst, hydronephrosis.
6. Supra-Diaphramatic Pathologic Conditions:
   Pleurisy
   Pneumonia—acute and unresolved
   Pericarditis
   Bronchitis and Bronchiectasis
   Pulmonary abscess.
7. Pathologic States with Diaphragmatic Signs and Symptoms but No Direct Pathologic Contact.
8. Accessory Diagnostic Devices:
   Pneumoperitoneum
   Thoracoscopy
   Pneumothorax.
9. Roentgen Consultation at the Bedside.
10. Foreign Bodies.

The Normal Diaphragm

The most astute observer and literary searcher can find no more adequate descriptions of diaphragmatic activity under radiologic control than those produced by Francis Williams[1] to whom we pay homage tonight. It was indeed a pleasure to me when I discovered that my studies, which naturally included his original text-book, would probably provoke his discussion as an original observer of diaphragmatic movement. How thrilling it must have been to Doctor Williams to first actually see a diaphragm rise and fall when before he had only heard it rise and fall with his tappings. The ecstasy and wonder of the pioneer observer is not often given to a physician. But Dr. Williams saw the advantages of the roentgen ray in clinical pulmonology and blazed a trial which has since been laid in concrete fact by succeeding radiologists upon his original surveys.

Normal diaphragmatic action consists in a synchronous rise and fall of the diaphragmatic shadows which are almost parallel, except for the fact that the left diaphragm makes a measurably deeper excursion than the right. The excursion of the right leaf is about 1.7 cm. and the left 1.5 cm. with quiet breathing. The excursion between full expiration and inspiration is 6 to 8 cm. upon the right and 7.1 cm. upon the left side. These are Williams' figures. They have not been altered by later orthodiagraphic measurements or subsequent studies. These are reliable figures for the average sthenic chest. The hypersthenic chest will have a short chest with greater convexity of the diaphragms with less average excursion but greater potential excursion by voluntary deep breathing. The hyposthenic patient will have a longer chest with diaphragms of less convexity, appro a triangular line to the chest wa very shallow excursion and less tial excursion by forced respirat fact, the hyposthenic, enteropto tient will frequently present no sion of the diaphragm upon d as they breath with the upper thc

The angles of the right dia shadows are acute at the cardio zone and at the costophrenic They are always acute in al types of habitus, but the deg acuteness varies, to-wit: the sthenic type is more acute th sthenic and the hyposthenic is less being almost 45 degrees at times variation in acuteness in the d types of stature or habitus must served when attempting pat analysis. For instance, an acute phrenic angle with marked conve the diaphragm in a hyposthenic spells pathologic significance. T mensions of the chest do not de the variations, but the habitus individual does.

Both diaphragms seem to m unison with an even, smooth curvature and with the right dia higher than the left. There can or more waves observable in th diaphragm without pathological cance due to uneven contraction cle bundles of this fan-shaped In the absence of clinical sy referable to the right phrenic are waves should be disregarded. T interesting evanescent observatio of not great pathologic importan may be seen at one examinatio to vanish in succeeding obser When, however, there is an an veloped with an apex toward th normality has ceased. This t shadow will be discussed tho later.

The flattening of the dia with inspiration and descent c greatly upon the expansion of th rib arch and the habitus of t ject. The hyposthenic type ex persisting flatness or lack of co which is only a concomitant of less, flaccid diaphragmatic muscl hypersthenic type has a very diaphragm shadow which only slightly by the expansion of the arches in their abdominal type piration.

The Pathologic Diaphr

Every intrinsic pathologic s the muscle, nerves and coverings diaphragm as well as specific

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 8, 1922.

above and below this border-line, influences its roentgen silhouette and movement. Cardiac pathology changes the phrenic angles and movements. Pulmonary lesions, acute and chronic, contiguous and distant, alter the mobility and contour. Spastic disturbances such as hiccough, sneezing, vomiting, tetanus, hydrophobia and poisoning offer graphic disturbances of outline which are of no clinical value. Chronic fibrotic changes in the lungs and pleura afford compensating disturbances of the phrenic outline which are deforming but only pathologic remnants.

The fact remains that there may be complete loss of activity of one side of the diaphragm without death or even without serious interference with livable existence. Paralysis, eventration, congenital absence, complete fixation of one diaphragm may occur and the other diaphragm and the intercostal muscles will afford compensatingly increased activity. But if both diaphragms are paralyzed or destroyed, death occurs. The diaphragm muscles are vitally concerned in the inflation of the lower lobes of the lungs and atelectasis of one lower lobe may occur with loss of activity of one diaphragm but if both diaphragms are paralyzed, as in post-diphtheric cases, massive collapse of the lower lobes of both lungs occurs with dissolution.

Inversion of the diaphragm, producing an abdominal tumor, may occur as a complication in extensive pleural effusion. If the pressure of the increasing pleural fluid completely collapses a lung and continues to develop, it must force the diaphragm to inversion. Riesman[2] submits an interesting case report upon this rare condition.

The diaphragm maintains its neutral position by its muscular tonicity. It is constantly harrassed by positive intra-abdominal pressure and negative intra-thoracic pressure. Any interference with these normal pressures serves to disturb the phrenic position. For instance, ascites forces the diaphragm up and lessens the excursion, sometimes to nil. Emphysema forces the diaphragm down and decreases its excursion. Pleurisy with effusion, depresses the diaphragm and may completely limit its activity. Pleural base adhesions tend to fix the phrenic excursion in keeping with their extent, strength, and cicatricial characteristics.

Irregularities of the diaphragm were found in four per cent of 3,754 soldiers followed through their service at Camp Lewis by Ralph Matson[3]. He takes exception to the usual decision that the tented appearance of the right or left diaphragm is caused by pleural adhesions. These tented deformities, not curves or waves, may appear and disappear thus showing the non-persistence of actual adhesions. Matson theorizes that these pseudo-adhesions are the result of the negative intra-thoracic pressure pulling the diaphragm by suction into a dimple of lung tissue which resists expansion by reason of bronchial involvement. The diaphragm really conforms to the base of the lung in normal breathing. The lung follows the diaphragm in excursion but the negative intrathoracic pressure demands that the diaphragm conform to the contour of the lung base. The shadows of the bronchi seem to pass into the apex of such a tented phrenic outline. When the bronchitis clears up and there is normal flexibility of the lung base, these tent-line irregularities disappear. Asthenic types with atrophied or toneless phrenic muscle display this phenomenon more readily. Matson offers excellent experimental proof of his theory.

The thymic child demands a correlative study of the diaphragm. One must watch the thymus at the phrenic phases of inspiration and expiration. Gerstenberger[4] shows the necessity of studying the appearance of the elephant ear shadow of the thymus at expiration and its vanishment into the heart shadow upon inspiration. We have carried out this procedure for some time in connection with observations upon the erectile characteristics of thymic tissue. It is a neat point for further study and standardization.

Anatomical studies of the diaphragm bring out the points that the diaphragm is not a single muscle upon either side but that there is the crural portion acting mesially and the parietal portion acting parietally or laterally. The diaphragm is in constant opposition to the intercostal muscles which serve to raise the arches of the ribs while the diaphragm pulls the anterior costal margins slightly inward. J. C. and G. Briscoe[5] afford some exhaustive anatomico-pathological articles. Thomas[6] speaks of the frequently observed phenomenon of a division of the right diaphragm shadow into a rounded median arc against the cardiac shadow and a flattened lateral arc. We have frequently observed this and without applicable pathologic significance. Thomas explains this by the greater length of the phrenic muscle bundles from the eighth and ninth ribs and weakness of the median and anterior muscle bundles. Reduction of negative intra-thoracic pressure favors the appearance of the arc, just as the diaphragm ascends in paralysis or relaxatio diaphragmatica, otherwise, eventration. "The reduction of thoracic pressure is increased, hence the arching during inspiration in pathologic conditions that restrict expansion, such as stenosis of trachea or bronchi, atelectasis, shrinkage, gangrene, etc." This arching does not indicate specific disease. It may be purely muscular.

The Concomitant Movement of Costal Margin

It behooves the radiologist to use clinical facts to assist his interpretation of shadow-values. The movements of the costal arch laterally and the anterior subcostal angle or margin inward are functions of the intercostal musculature during respiration. Hoover[7] calls our attention to the values of such clinical observations and many reporters upon eventratia, vs. hernia diaphragmatica, have based their differential clinical diagnosis upon these facts without radiologic assistance. A brief analysis of Hoover's clinical article gives us this outline:

1. The costal margin *moves outward*, symmetrically, in paralysis of the diaphragm, following diphtheria or poliomyelitis.
2. The costal margin *moves inward* toward median line (a) with paralysis of the intercostals following cord injuries to the cervical and upper dorsal vertebrae and (b) in flattening of the diaphragm due to emphysema, bronchiectatic spasm, asthma.
3. Costal margin *moves to one side more than other* with accentuation of arch of the diaphragm, in acute diseases of the liver, subphrenic abscess and impairment of diaphragm. The only supraphrenic condition offering this action is massive collapse of the lung. The differential sign between massive collapse of lung and subphrenic abscess is displacement of heart and lung to right in massive collapse. Case history is demanded where fibroid changes of pleura are exhibited.
4. The costal margin moving toward median line means that the diaphragm has gained the mastery and the diaphragm therefore is depressed; the intercostal musculature is paralyzed and the rib arch fails to move, i.e., pneumo-thorax, large pleural effusions and positive intra-thoracic pressure.

In a combination of pyopneumothorax and subphrenic abscess all these signs fail.

With peritoneal tuberculosis, Foerster[8] reports a flattening of the phrenic convexity and obliteration of the costophrenic angle, bilateral elevation and decreased excursion. This is almost a similar picture to what we have seen in ascites. Foerster further states that if these shadow values are unilateral they mean paranephritis and that cholecystitis, pyelitis and appendicitis produce no phrenic alterations. Pan-

coast[9] has reported the elevation of the left diaphragm with fixation in perinephritic abscess, with this further satisfying observation that when the patient was shaken quickly in lateral direction a wave of fluid was visible. In a second case Pancoast was unable to reproduce these signs in the recumbent posture of the patient.

Such observations as the above require an annalytical interpretation. The splash of level of stomach contents could be confused with Pancoast's shadow values. Upon the right side, the liver density would interfere in vertical fluoroscopy and as Pancoast says, the signs do not register in the recumbent position of the patient.

SPECIFIC PATHOLOGIC CONDITIONS

Diaphragmatic Hernia. The roentgen reports upon this are voluminous. They seemed to crash down all at once. Almost no journal went to press without a case report. Inasmuch as this is usually a left-sided condition we will not proceed carelessly. Quite naturally a defect can occur anywhere in either phrenic leaf with a congenital or traumatic origin. The x-ray opaque meal examination is universally admitted by radiologists and Philistines as the proof of the condition.

The recent war produced many cases of traumatic phrenic hernia. English literature especially is replete with excellent case reports. The general distribution and accessibility of roentgen apparatus accounts for the surge of reports of hernia diaphragmatica of congenital and acquired types. Many of these reports frankly admit the diagnostic conclusiveness of roentgen examinations, while others magnanimously or grudgingly include the roentgen findings as corroborative evidence.

Diaphragmatic hernia may be congenital or traumatic in origin. The congenital type does not always give symptoms until some trauma forces the attention, if the patient lives to adult life. Many still-born children have large diaphragmatic defects. The condition usually occurs upon the left side, although Eppinger found 21 right-sided cases among 74 studied. The symptoms seem to depend upon the size of the defect or upon subsequent trauma. Hernia diaphragmatica is more often confused with eventration or relaxatio diaphragmatica.

The roentgen findings of diaphragmatic hernia include (1) an abnormal contour and arching of the affected diaphragm; (2) irregularity of the arch; (3) with lung shadows visible through the gas-filled abdominal organs above the diaphragm shadows; and (4) the opaquely-filled viscera are discovered in the thorax above the diaphragm; (5) the movement of the affected diaphragm offers no characteristic shadow-values as this probably depends upon the extent of the defect and the size of the hernial sac; (6) the roentgen findings may vary in extent due to temporary reduction of the hernia and fluctuation of the visceral contents of the hernial sac.

Eventration of the diaphragm consists in the relaxation and elevation of a phrenic leaf with concomitant higher position of the normal abdominal viscera below the particular leaf. Synonymous terms are insufficiency, relaxation, dilatation, elevation, etc. The roentgen findings include (1) the high position of the diaphragmatic dome with (2) a smooth contour and (3) no gas shadows of abdominal viscera above; (4) the movement of the diaphragm is paradoxical, that is, upon inspiration the diaphragm ascends and upon expiration it descends.

Confusion may arise from the elevated position of the diaphragm due to old pleuritic adhesions, but the irregularity and fixation of these shadow values should be sufficient to discriminate easily. Over 90 per cent of cases are left-sided. It is usually congenital and rarely gives symptoms which originate intrinsically. It is discovered because of other disease or because of disease in the displaced viscera. It is easily confused with pneumothorax, clinically, because of the tympanitic note produced by the hollow abdominal viscera thus displaced; but this confusion is not transmitted to the roentgen findings, which are remarkably satisfying.

Paralysis of the diaphragm may be unilateral or bilateral. When unilateral it is usually the result of trauma to phrenic nerves. When bilateral it is of central origin, frequently the case in diphtheria. The position of the diaphragmatic domes is always high. They offer no movement or traction and therefore, the intercostal muscles gain mastery and pull costal arches sharply outward with paradoxical displacement of diaphragm shadow. There may be atelectatic changes in the adjacent lung tissue. In bilateral diphtheritic paralysis, massive collapse of the lower lobes occurs.

Probably I have not given sufficient space to the discussion of paralysis. There is certainly a massive literature. But it seems that if the condition is bilateral from disease or injury the case rarely occasions roentgen consultation, and if unilateral the symptoms are not severe and there is no demand for roentgen study. Our only confusion is eventration and the conditions seem almost identical, radiographically and clinically, excepting that eventration is usually congenital and paralysis i
quired.

SUB-DIAPHRAGMATIC PATH
LOGICAL CONDITIONS

Abdominal Ascites, Etc. Let u
pose of the gross abdominal enl
ments such as ascites, leukemia
ovarian cyst briefly, inasmuch as
only serve to displace the right
phragm upward by pressure again
liver, with these conditions the
diaphragm does not seem to be
placed upward because the right
rises so much more easily. This
supposes normal phrenic mucul
Contrary to the apparent force
enlarged spleen upon the left
phragm, one notes that the splee
tends downwards, displaces the sto
outline to the right and seems to
the left abdominal contents wit
clock toward the liver and thus
ually displays its force by ele
the right diaphragm. This pher
is of little practical value and a
of minor importance.

Hepatic Lesions of intrinsic
such as cyst, abscess, angioma
tumor have little influence upo
right diaphragmatic outline unles
are at the superior margin and
rare. With them, the excursion
phrenic leaf is lessened and if th
inflammatory invasion of the phre
flections of the peritoneum, this
muscle exhibits spasm (hiccoug
painful movement (asthma). Ou
sonal experience indicates that th
trinsic lesions produce more s
values upon the gastric contou
upon the diaphragm, with the o
ception of an isolated hepatic a
producing a bulging of the phren
corresponding to its superior cont

Subphrenic Abscess: The ro
analysis of this condition is usuall
cerned in eliminating or provi
presence or absence of pathology
the diaphragm, either as a prim
complicating pathological con
This is a real border-line disease
the condition that prompts all
have said before and all that I n
permitted to say hereinafter. It
that there is no great difference b
the clinical symptoms of patho
disturbance immediately above or
the diaphragm. Without the
history or the surgical sequence o
plications, there is very little dif
in the symptomatic and phonet
play of a basal pleurisy with sl
fusion and subphrenic abscess.
supra-phrenic condition holds t
phragm fixed or pushes it dow
while the subphrenic abscess pus
diaphragm up and fixes it.

Therein lies the efficiency of
gen analysis. And therein also
difficulty. Right here, the roent

gist becomes a diagnostic hero or an evasive coward. Here rests the decision of love at first sight with a roentgen analysis of excruciating service to the patient or of executing damage to the subsequent history of the case. A vacillating roentgen reading is of no value here. The demands of the case are uncompromising. The roentgenologist must know his fundamentals, read his shadow values without bias or sympathy and then stick by his guns, right or wrong. Thus equipped he will be right 90 per cent of the time, and God knows there is a human equation of fallibility.

What are the complications above and below this border line muscle which make for symptomatic confusion? Above, they are pleurisy and pneumonia; below, they are subphrenic abscess and hepatic abscess and general peritonitis.

What primary lesion precedes this diagnostic dilemma? Usually an appendicitis (postoperative) or a perforating duodenal or gastric ulcer; rarely, thoracic pathologic conditions. Certain combined statistics (Maydh, Gruneisen, Perutz-Gusted by Norris and Landis[10]) show intra-thoracic origin in 18 out of 448 cases.

No attempt will be made to describe the pathological anatomy or symptoms. There are many excellent surgical papers of recent origin which are sufficient. We are concerned with the more or less simple roentgen shadow values or silhouettes which define an infection as above or below the borderline muscle—the diaphragm. The x-ray findings are usually so simple and exact that they do not seem sufficient, but they really are. The fault usually rests with the vacillating roentgenologist who wavers in the face of diagnostic victory; who hesitates when he should charge the ramparts of symptomatic indecision; who neglects his opportunities to establish his ability at roentgen interpretation.

To me there are two areas in the body where failure to stand by one's diagnostic guns spells ignominious defeat. The one is brain abscess, the other is subphrenic abscess. He who hesitates is lost. I would rather be right than president. I would rather be wrong than vacillating with the winds of conjecture.

The roentgen findings of subphrenic abscess demand a high diaphragm, well-domed, upon the right side with fixation or extremely limited restriction of movement. A preceding abdominal infection or perforation serves to fortify the diagnostic importance of these roentgen signs. The presence of pleural reaction, even with effusion, does not change the values of the above shadow-values.

More intimate analysis of these gross characteristic shadows provides the disappearance of the costo-phrenic sulcus or angle because of the approximation of the phrenic leaf to the lateral chest wall as the phrenic dome ascends and fixes itself. The presence of an air bubble below the curved phrenic dome, which changes level with postural change, indicates the presence of gas and only fortifies the sub-phrenic nature of the conditions.

Supra-Diaphragmatic Pathologic Conditions

These are numerous and will only be discussed briefly in their relation to diaphragm shadow values.

Pleurisy with effusion tends to fix the diaphragm, to obliterate the costophrenic space, and to present a concave upper margin which reaches higher at the periphery of the chest and only presents a fluid level if air is present. It only presses the diaphragm down when the pressure or fluid increases without extension of the upper pleural margins. The chronological sequence of pathological extension is easily depicted by roentgen examinations.

Pericardial effusions give triangular heart outlines with loss of acuteness of the cardiophrenic angles and loss of pulsation shadow to the heart outline.

Pneumonia shows the central opacity of the lung tissues, with or without the overlapping pleural reactions. The fixation of the contiguous diaphragm is a matter of propinquity.

Pathologic States Without Contact Diseases

Paralysis has been described.

Spasm of clonic and tonic character: Clonic spasm includes hiccough and paroxysmal sneezing. Roentgenologically they are not as interesting as their origin. They will probably be of rare observation as time and prohibition wears on. Tonic spasm occurs in tetanus, hydrophobia and poisoning.

Tuberculosis of the apical areas provides a diaphragmatic restriction which has provoked endless discussion. Williams was the first to assert that the diaphragm of the affected side fails of an excursion equal to that of the healthy side. This has failed to obtain universal acceptance. It has been denied entirely by certain French observers. It is only appreciable by fluoroscopy. It is delicate. Undoubtedly, the rapid stereoscopic plates have forced attention away from this fluoroscopic finding.

Williams states, under the title of *Appearance of the Lungs Upon the Fluorescent Screen in Early Tuberculosis*, that "The apex of one lung is seen on the fluorescent screen to be darker than normal, owing to the increased density of this portion of the lung; and second, the excursion of the diaphragm is seen to be restricted on the affected side, and usually in the lower part of its excursion."

The difficulty seems to be one of meticulous roentgen observation. The pathological foundation for this sign has ample support, but its universal appreciation has been tardy. Perhaps it is a matter of education as well as observation. It is certainly easier to see this phenomenon than to attempt to percuss its presence. And yet many clinicians attempt to elicite this sign by percussion note and surface meeting. Crane[11] says: "The diaphragm is the vital barometer of the lungs, and may give the first signs of coming clouds above." Duken[12] states that Williams' sign does not hold with children. Watsham and Overend attempt to explain this sign by (1) pleuritic adhesions or (2) impairment of pulmonary elasticity or (3) reflex inhibition of muscular action by vagus irritation or (4) phrenic nerve involvement at apices.

Personally, I used to depend upon Williams' sign because I looked for it with the fluoroscope, but stereoscopic plates seem to dull my appreciation of its value at present. It always seemed to me that it was an early finding of nature's attempt to put a lame lung at rest—a sort of spastic splinting of the affected thorax. The persistence of the sign was affected by the lung becoming inured to the disease with a demand for compensatory air-space in the lower chest. In later stages the sign again manifested itself because of pleural adhesions and fixation. This sign surely requires further confirmation or refutation. Perhaps if we went back to fluoroscopy we would learn more about it. This sign of Williams is not lost to roentgenology. It is simply enjoying a recess while high-powered plates have their inning.

Accessory Diagnostic Devices

Pneumoperitoneum is not without certain elements of danger. The analysis of the simple roentgen values should be sufficient. The distention of the abdomen with air could be harmful in diaphragmatic hernia and phrenic defect. Filling the viscera with air or opaque media is more to the point. The Trendelenburg position is useful in studying hernia and eventration.

Pneumothorax by artificial means may be of value in studying the adhesions at the diaphragm of old pleural origin.

Thoracoscopy offers highly specialized values of doubtful advantage.

These special adjuvant diagnostic procedures may serve those who are not grounded in clinical analysis of symptoms and the roentgen study of shadow values. They are not necessary to the careful student of disease.

In closing may I direct your attention again to the paragraphs upon subphrenic abscess, for these are my principal arguments—the diagnostic milk in the cocoanut—the stuff that roentgen heroes are made of.

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Gall-Bladder Disease with Special Reference to Fluoroscopic Findings*

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A SURVEY of the literature does not throw much light on the interpretation or value of the fluoroscopic findings of the pathological bladder. It is true that mention is made of the so-called "indirect findings" basing these usually on fluoroscopy substantiated by plates, but as a whole there seems to be a universal attempt to discredit this method. It is difficult to appreciate why the fluoroscopic findings of a penetrating ulcer of the stomach, of such size and so located that it can be seen without any difficulty, or the fluoroscopic findings of a pneumothorax, etc., should not have the same interpretive value as a plate or film. Applied to gall-bladder disease these findings may not be so marked, yet why question the importance of definite fluoroscopic signs that properly interpreted may mean as much and in some instances more than plates? I freely admit, fully appreciate, and do not underestimate the valuable work of George, Kirklin, Pfahler and others as to the conclusiveness of the gall-bladder outline, when shown, being practically pathognomonic of a diseased gall-bladder, yet I question the converse, that failure to show a gall-bladder shadow on a plate signifies the absence of a pthology of this organ.

In a very recent publication the author makes this statement: "Fluoroscopy has been of no practical value in this line of work, in fact in some ways it has seemed an actual detriment to the perfection of gall-bladder diagnosis. Except by remote, indirect methods, there is nothing within the power of the fluoroscope to give the least information regarding the pathological gall-bladder." It seems fluoroscopy is condemned by a number of writers even though their so-called "indirect findings," obtained from the plates, are the direct findings of the fluoroscope.

It is my belief that the fluoroscopy has a very definite and decided place and value. Many times when the findings in the plate were negative I have seen the indication of a pathological gall-bladder shown in the fluoroscope. On the other hand, I have found the reverse equally true, the percentage being in favor of the plate. Again, the routine use of the fluoroscope assures us of the absence of gross gastric or duodenal lesions. The point I desire to make is the proper correlation of the fluoroscopic findings to the ultimate roentgen conclusions.

In order to cover the subject I have arbitrarily divided the findings under six headings, which will be considered in order: (1) Stomach; (2) Bulbus Duodenei; (3) Duodenum and its behavior beyond the cap; (4) Fixation and pathological immobilization; (5) Localization of tender points; (6) Differential diagnosis.

Stomach

In checking over a large series of patients there seems to be nothing in the fluoroscopic examination of the stomach to warrant the drawing of any definite conclusions. The peristalsis does not appear to be of any characteristic type, except in those few cases of pyloric or duodenal obstructions due to abnormal and infrequent ligamentous adhesions of the gall-bladder. In this event it is quite obvious that a malignancy or ulcer must be differentiated from a simple cholecystitis or a cholecystolithiasis. Patients afflicted with gall-bladder disease usually have a very large Magen Blasse, swallowing and belching continuously, complaining of gas pain, due to "gas in the stomach," even though very little or no gas is present.

The presence or absence of fluid has no special significance, as this occurs so frequently in other conditions. A peculiar indirect sign often found present is the feeling of fullness which these patients complain of simultaneously with the appearance of the barium meal in the duodenum. A positive sign is the presence of a gall-bladder seat in the greater curvature of the antrum. This might be seen in either the upright or prone posture with or without rotation under the fluoroscope, the guidance of which has been of tremendous value in properly directing the central ray for plate exposure with the patient in the correct position to bring out this pressure seat to the best advantage just as in ulcer.

Bulbus Duodeni

The bulbus duodeni has been reported as becoming very large and dilated in gall-bladder disease, failing to empty as rapidly as a normal cap. This does not seem to hold true except in few instances, as many normal cases have been observed to do likewise, this varying with the gastro-intestinal tonicity. A bulbar defect when observed may well be considered at this point and if smooth and concave, a typical gall-bladder seat, it can readily be recognized with as much certainty as in a plate. It is found usually pressing into the outer border, although, the gall-bladder may press into the inner border, or even the upper. On several occasions the fundus of the gall-bladder has been noted lying across the bulbus duodeni producing a defect entirely across the

* Read at Midyear Meeting of the Radiological Society of North America, St. Louis, May 19, 1922.

lumen of the cap, showing as a bilateral depression, much like ulcer. A characteristic gall-bladder seat as seen under the fluoroscope, has just as much interpretative value as when seen in a plate, as the normal gall-bladder does not produce this pressure deformity. Furthermore, by rotation, a gall-bladder seat can be demonstrated in many instances when the postero-anterior projection on a plate hides it.

Postoperative pathology such as adhesions, following a pyloroplasty, cholecystotomy, duodenal ulcer, etc., may increase the difficulties of fluoroscopy to such a point as to render all findings practically worthless.

Duodenum and Its Behavior Beyond the Cap

The changes in the second and third duodenal segments and the behavior of the barium meal in the intestine at this point has, to me, taken on a very significant aspect. Normally when the barium meal passes out of the bulbus duodeni, it passes readily and quickly through the second, third and fourth duodenal segments, into the jejunum. In gall-bladder disease this changes, the duodenum being usually somewhat dilated. The opaque meal shows a pronounced stasis, and the barium is regurgitated to and fro in the second and third segments and frequently even empties back into the bulbus. This phenomenon may be observed in both the upright or prone positions, care being taken that there is no spinal pressure, constricting the duodenal lumen, when the patient is in the latter position. It is at the time especially that patients so frequently complain of that feeling of fullness. At operation duodenal dilatation usually is substantiated, not very pronounced, yet definite. Pathologically this peculiar behavior is due to a duodenitis, a common associated finding in gall-bladder disease, the barium acting in the duodenum just as it does in the colon in a colitis.

A gall-bladder seat may be demonstrated and often is in the duodenal arch, and this is just as definite a finding when demonstrated under the fluoroscope as when shown on a plate.

Fixation and Pathological Immobilization

In all normal individuals, except the hypersthenic type, the pylorus, duodenum and hepatic flexure are freely mobile. In the hypersthenic individual with a hypersthenic or steer-horn stomach the pylorus is located far to the right and often directed posteriorly. The hepatic-duodenal ligament is also very short. These factors contribute to hold the pylorus and duodenum practically immobile. In addition the hypersthenic patient has a heavy abdominal musculature. All this combines to make it impossible to determine the mobility or immobility of these parts so that even if the duodenum is plastered down by pericholecystic adhesions unless there is a gall-bladder seat present, the fluoroscopic findings are worthless. In all other types of patient, fixation of the duodenum against the under surface of the liver, pulling of the stomach to the right with pyloric fixation, abnormal angulation of the duodenal arch, squaring of the upper margin of the bulbus by traction with a full stomach, either in the upright or prone posture, usually means a pathological gall-bladder. These findings even in the absence of a gall-bladder shadow in the serial plates are very significant and have a definite and decided value.

At 24 hours the hepatic flexure can usually be well outlined. Formerly the hepatic flexure as seen in the upright and supine position will show a considerable range of mobility. With adhesions present to the flexure it becomes drawn up under the costal arch against the liver. It is true that plates can also be used for this purpose, but it is much simpler and less expensive to observe this fluoroscopically. Again at 24 hours on numerous occasions, the appendix has been observed to be well filled and instead of occupying its usual normal anatomical position it was adherent against the under surface of the liver pulling the cecum up with it. It can readily be seen that with adhesions due to this condition, the entire hepatic flexure may be distorted and abnormally held. We have had five cases of this type during the past year.

Localization of Tender Points

The localization of gall-bladder tenderness is certainly facilitated to the highest degree by the fluoroscope. Tenderness along the liver border which can be shown to be entirely outside of the gastro-intestinal tract certainly is highly suspicious of a pathological gall-bladder and frequent observations showing no encroachment of the gastro-intestinal tract upon the tender area can easily be made. Carrying these observations through for 24 hours and carefully observing the hepatic flexure one can again show the relation of this tender point to the colon. Should any portion of the gastro-intestinal tract overlie this area, then it requires differentiation between an intrinsic gastro-intestinal lesion or a gall-bladder.

Differential Diagnosis

Frequently a pathological gall-bladder must be differentiated from a pyloric or duodenal ulcer with or without adhesions, pyloric ulcer, gastric ulcer and pancreatitis by means of an opaque meal, fluoroscopy and serial plates. Differentiation between a pathological right kidney or neoplasm of the hepatic flexure may require fluoroscopy and an opaque meal, enema and plates. Cardiovascular diseases, etc., can often be determined by the fluoroscope and plates. Fortunately in pyloric or duodenal ulcer, as a usual rule, there are few or no adhesions of the pylorus or duodenum. In pancreatic pathology a differential clue can frequently be obtained, when the head of the pancreas is involved and is enlarged causing the duodenum to take a wide outward swing to the right. Three such cases, however, proved to be the gall-bladder adherent to the head of the pancreas. Neoplasms of the hepatic flexure and a pathological appendix, abnormally fixed in the gall-bladder region, can be readily differentiated at 24 hours by fluoroscopic examination and by the use of the opaque enema. In case any stone shadow be present in the gall-bladder area, the shadow not presenting the characteristic gall stone outline but having a density that appears more like that of a renal stone, fluoroscopy will show this type of stone to be either in the gall-bladder or in the kidney. Lateral rotation will show this shadow to be either anterior or posterior, either in the gall-bladder or kidney area. Unfortunately this can be done in only a small percentage of cases.

In conclusion let me state that I do not advocate fluoroscopic methods in preference to serial plates and neither do I advocate serial plate methods entirely in preference to fluoroscopy. Do not misunderstand me. It is my firm conviction that the fluoroscope is of inestimable value in gall-bladder work and at least in our work, has often given the only sign indicating pathology of this viscus. This sign is that of duodenal stasis and dilatation. This sign may also be present in duodenal ulcer, pyloric ulcer, chronic appendix, colitis, arterio-mesenteric occlusion, ulcer of the duodenum beyond the bulbus duodeni. A complete gastrointestinal examination should be made in every suspected gall-bladder and every gastrointestinal examination should include serial gall-bladder plates so that these previously mentioned lesions may be ruled out. Just as one clinical symptom may indicate the diagnosis, so one roentgen finding may indicate the correct diagnosis, whether it be by means of the fluoroscope or serial plates. It is not a question of methods, it is simply that of using every roentgen facility at our command for the benefit of the patient. Let me again repeat—the absence of a gall-bladder shadow in a series of plates does not necessarily imply that there is no pathology present.

Toxic Thyroid with Pathological Findings After Radium Treatment*

R. E. LOUCKS, M. D.
Detroit

IN THE clinical classification of toxic thyroid there are two distinct types—
Thyrotoxic adenoma
Exophthalmic goiter

It is a question whether simple adenoma of the thyroid may be caused by lack of iodin intake, calcium iodin balance, or by the parenchyma cells surrounding the alveolus being activated by some endocrinal stimulation. It may remain for years as a simple physiological enlargement, or it may become diffuse. The diffuse type utilizes the rest cells of Wolfler and with a hyperplasia of the stroma forms a new growth.

The symptoms of thyrotoxic adenoma progress slowly, but gradually increase in number and severity until a hormone balance is established, when there may be partial cessation of activity. Many symptoms remain unchanged in this quiescent period, such as rapid and irregular heart action on exertion, vasomotor disturbance, nervousness, irregular menstruation in females, gastric distress, tremor, etc., but with no loss of weight and no increased basal metabolism. The balance is held until such a time as pregnancy, lactation, focal or acute general infection stimulates the endocrine function, producing an increased activity of all symptoms until the individual becomes toxic.

The exophthalmic goiter may be primary or a selective type without any enlargement of the thyroid gland or it may develop in conjunction with a toxic adenoma. With a few exceptions the course is typical, the symptoms rapidly increase in severity until a crisis is reached, when they subside slightly. This period may last from eight to fourteen months, when another exacerbation occurs and another crisis.

Kendall, in 1914, identified thyroxin as the active principal of the thyroid gland.

Du Bois has standardized basal metabolism in the normal individual and Plummer has proved by extensive studies that thyroxin in excess raises the metabolic rate.

Hyperthyroidism designates over-activity and is characterized by definite clinical findings of increased basal metabolism and symptoms of tachycardia, nervousness, tremor with trophic, myocardial and other degenerative changes in the toxic stage.

The relative stability of thyroxin is held in obeyance by the normal physiological metabolism. But if the burden of excessive and prolonged secretion overcomes the normal physiological compensatory power there is a "whipping up" of all the endocrine units, first from hormone stimulation, then from the overwhelming amount of toxin secreted. Thus one link in the chain of internal secretions changes the normal function of all, illustrating what may happen when harmony is displaced by discord.

Diagnostic points in differentiating a toxic thyroid from a compensatory thyroid enlargement are:

Increased basal metabolism, tachycardia, pyrexia, tremor, gradual loss of weight, attacks of diarrhœa and glycosuria.

The thyroid gland is known to be the activator of metabolism, and, as the clinical test of basal metabolism has been proved, the indication for remedial relief presents itself whenever a sufficiently high basal metabolic rate is demonstrated. When medication and other measures fail, you must choose between surgery, x-ray or radium.

The physiological findings after radium treatment could be reported *en masse* by stating that there was a general return to the normal of all pathological manifestations. To clarify any illusions the different changes will be noted. The merits of radium treatment are strikingly shown in the number of our cases where the metabolic rate was taken before treatment and every three months thereafter. Some were normal in three months, others nine months after treatment. Those with a high systolic and a low diastolic blood pressure showed within a few weeks a more even balance of pulse pressure.

The improvement in blood pressure was noted three years before the installation of the metabolic apparatus.

Tachycardia, even in muscular exhaustion when there is dilatation and valvular incompetence, is soon controlled so that an apex beat of 160 will within a month record one of 100 or 120. Myocardial degeneration with fibrillation (unless there is a general arteriosclerosis) in the later stages will be relieved.

Tremor of the hands, fingers and lower limbs appears as one of the first symptoms and varies in different individuals. It is one of the first symptoms to subside after radium treatment.

Hyperidosis is usually confined to the palms of the hands and soles of the feet, but in women at the climacteric it may involve the whole body surface. It usually subsides after a few months.

Trophic changes of the hair, nails, and cuticle show signs of improvement after the toxicity is controlled.

Within six weeks there is an increase in body weight, unless there is an extreme ptosis of the viscera.

In the adenomatous type there is a general decrease in the size of the enlargement which varies and appears to depend on the cystic condition present.

The specific physiological changes are many and are noted in the circulatory, digestive and nervous systems.

The blood coagulation time is lessened within a few weeks.

The leukocytosis found with a hyperactive thyroid is reduced to or below normal within a month.

The red blood corpuscles become richer in hemoglobin so that there is a distinctly higher color index.

The blood chemistry shows an increase of blood sugar in hyperthyroidism, which is brought under control through carbohydrate metabolism.

Digestive disturbances, such as hyperacidity and flatulence with periodic attacks of diarrhea are at first lessened in severity, and within a few months are completely controlled.

As a sequence of the digestive disturbance, with absorption of foreign proteins and the toxic condition present in very active hyperthyroidism, there will develop symptoms of headache, nausea and acetone odor of the breath. This condition of acidosis was found in three of our cases and was treated with glucose and alkalies for two days prior to the radium application and for several days afterward. There was a rapid response to medication and a gratifying result from the radiation. The balance of thyroid secretion, the main factor in the vicious circle, is restored.

* Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 8, 1922.

Pulmonary Abscess Roentgenographically Considered*

WILLIAM H. STEWART, M. D.

New York City

PULMONARY abscess most commonly occurs after tonsillectomy and is due to the aspiration of an infected tonsillar plug. It shows itself, on an average, about ten days after operation and is characterized by severe stabbing pain in the chest, cough with foul expectoration, fever and malaise. A number of cases have been observed after other operative procedures, some of which are clearly the result of a septic infarct.

Pneumonia, either lobar or lobular, is second among the most common causes of pulmonary suppuration; it appears early, as frequently in insufflation pneumonias where there is a very rapid destruction of the lung tissue by gangrene with the formation of large cavities; or, as a late suppuration, the result of chronic pneumonia—the latter is very often observed complicating influenza-pneumonia. Such abscesses are usually multiple rather than single. There is also an insidious form occurring usually after exposure, in which the abscess is distinctly the primary lesion, the accompanying pneumonia secondary. Many cases of abscess of the lung have been reported following infection from the accidental intake of foul water into the lungs; these cases have been observed mostly during the summer months when the bathing season is at its height, especially in rivers or bays receiving town or city sewage. A number of cases of empyema, more often sacculated than general, break through the visceral pleura, and are responsible for pulmonary abscesses.

Lung abscesses may involve any portion of either lung. Following aspiration they usually appear in the upper lobes, while following infarcts or pneumonia they more often appear in the lower lobes.

While the clinical picture and physical examination are usually sufficient for diagnosis, the x-ray is especially valuable in locating the lesion and giving accurate information as to the extent of the process and the presence or absence of associated pathological conditions.

The early process, as seen roentgenographically, consists of a localized pneumonitis of varying degree. The character of the shadow is more often oval than circular in shape; within the center of this shadow of infiltration soon appears a lighter area indicating cavity formation. The roentgenographic appearance depends upon the amount of secretion present; if the cavity be filled, one cannot distinguish between the infiltration and the fluid; and, if only partially filled, a fluid level can be seen with a clear area above. The infiltration varies greatly in character; usually the more acute the process, the more dense the shadow. Abscesses of old standing have well established pyogenic membranes and very little involvement of the lung surrounding the cavity. Before softening or gangrene occurs it is impossible to determine whether one is dealing with one or more abscesses.

If a single one is present, it is called a simple lung abscess and if multiple abscesses are in evidence, the case is diagnosed as bronchiectasis. Autopsies have shown that many cases exhibiting, roentgenographically, only one cavity, actually have one main abscess surrounded by numerous smaller cavities.

It has been clearly demonstrated that no case of lung abscess is completely cured nor out of danger of a "flare up", unless every roentgenographic sign of the lesion has disappeared, even though the patient be symptom free.

The most common lesion mistaken, roentgenographically, for lung abscess is a small sacculated empyema. To say whether the abscess is just beneath or just above the pleura is most difficult, as the process may be not only pleural but pulmonary as well; in this instance, the presence or absence of excessive foul smelling sputa determines whether or not the pulmonary structures are involved. A fistula between a sacculated empyema and a small branch bronchus accounts for the presence of the air bubble above the fluid level, but this opening between the lung and the pleural cavity may be so small or located so high in the empyemic cavity that only limited drainage will occur, thus confusing the diagnosis. In making the differentiation, one must be sure that the air bubble is not the result of needling; sacculated empyema (showing air in the upper portion of the cavity, which has been introduced through the aspirating needle) has more than once been mistaken for lung abscess.

The frequent occurrence of hemorrhage in the chronic form of lung suppurations, combined with cough and excessive sputa, may lead to a diagnosis of pulmonary tuberculosis. Cavities in the latter disease show little if any surrounding infiltration; position, laboratory findings and manifestations of the disease elsewhere in the lungs stamp it as tuberculous.

Certain cases of sarcoma of the lung simulate the multiple form of pulmonary abscess. The recognition of this type of malignancy is rather difficult and is usually discovered only on the autopsy table.

At the annual meeting of the American Roentgen Ray Society, held in Minneapolis in September, 1920, a joint paper was presented by Dr. Henry L. Lynah and myself, covering the treatment of pulmonary abscess by means of injecting bismuth-subcarbonate suspended in sterile sweet-oil, directly into the abscess cavity through a bronchoscope. The untimely death of Doctor Lynah has set back the work considerably, but the treatment is again being carried on by Dr. Richard Jordan and Dr. John D. Kernan, Jr., at the Lenox Hill Hospital, New York.

The author firmly believes that all cases of lung abscess, either simple or multiple, should submit to a thorough course of bronchoscopic treatment before resorting to surgery. While there is no question that a certain percentage of lung abscess cases will recover spontaneously, one should not wait for the possibility of such an event; bronchoscopic treatment should be commenced as early in the case as possibile, manifestations of an acute infection should not be a contraindication.

As soon as the lesion is recognized, the establishment of free drainage by the bronchoscopic method is an immediate indication. In many cases the simple procedure of clearing out the bronchi by suction and opening up the swollen and edematous bronchus leading to the abscess will be sufficient. More difficult cases require injections of solution of silver salts, such as collene or silver nitrate. If the process be persistent, injections of the bismuth suspended in sterile sweet oil can be resorted to. I am confident that some cases show improvement when treated with the x-ray after injection of the bismuth, probably not only due to the effect of the primary rays, but also the secondary rays emitted from the bismuth.

Frequent roentgenographic examinations should be made while the patient is undergoing bronchoscopic treatment; by this means, as well as by clinical manifestations, the progress of the case can be determined. In demonstrating

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 6, 1922.

this lesion roentgenographically, the chest should be examined in all positions, the prone lateral position, with the tube in front and the plate behind, has proved most satisfactory in the hands of the author; especially is it valuable when examining patients who are unable to maintain the erect posture. That cavities are more readily mapped out in this position is, no doubt, due to the fact that the abscess is more often oval than otherwise, with the long diameter extending from the root toward the periphery.

Cases of lung abscesses, in which there is a large amount of induration with a minimum amount of softening, and many of the multiple form, do not respond well to bronchoscopic treatment; in these surgery must be resorted to. The question of how long to wait before surgical procedure is a debatable one; some cases received bronchoscopic treatment weekly for almost a year with a final recovery.

It is not within the scope of this paper to deal with the surgical requirements. It is necessary, however, for the roentgenologist to give the surgeon all the knowledge possible as to the exact location of the abscess or abscesses. Localization, by means of the x-ray, in positions other than the one in which the patient is to be placed on the operating table is not satisfactory. What information can be given by this method must be ascertained during a certain recorded phase of respiration, and one must be sure that the central ray is directly in line with the shadow of the abscess. In making the localization the relation between the abscess and bony landmarks must be described, rather than an attempt made to mark the patient's skin. Surgical flaps in thoracic work are considerable and may disturb the surgeon when following the localization.

The ideal method of localizing a lung abscess is by fluoroscopy, using the adjustable head fluoroscope, after the patient has been prepared and placed in position on the operating table. The x-ray can be procured by means of a small transformer and tube immersed in oil, which can safely be used in the operating room.

Many cases of lung abscess have a localized area of pleuritic adhesions over the involved area of lung. Dr. Willy Meyer has suggested that a stereoscopic x-ray examination, after a pneumothorax, would map out this area and lead to more accurate localization of the abscess. Surgeons are reluctant to needle the lung in searching for a pulmonary suppuration.

Sarcoma of Back, with Report of Three Cases*

B. H. WAGNON, M. D.
Atlanta, Georgia

I AM bringing this subject to your attention for three reasons, namely:

(1) That these tumors occurred in the same position and from the same origin, namely, between the shoulders and from rhomboid fascia.

(2) That they were not malignant to start with, but had been removed for ordinary lipomas.

(3) That they occurred in persons of widely different ages and produced no metastasis although they recurred rapidly after each removal.

It is not surprising to find these tumors of spindle cell type; they are very common, of widespread occurrence, develop chiefly in subcutaneous or submucous tissues, fascia, muscles and peritoneum, etc., and according to Ewing they represent the purest form of fibroblastic neoplasm.

As a rule they are of low grade malignancy and I have no doubt that the first occurrence in these cases was simple lipoma.

These tumors usually occur singly, although there are numerous reported cases of multiple growths. Their form is rounded or lobulated and the edges are not sharply marked. In the fibrous small cell tumors they are very hard, but in the large cell growths, they are softer and more elastic.

Of the specific cause of sarcoma little is definitely known. These tumors demonstrate the great proliferative capacity of mesoblastic cells released from the restraints to growth. According to Ewing, "This capacity may reasonably be estimated as even greater than with most epithelial tissues. It is commonly assumed that normal adult cells are incapable of such great proliferation as occurs in sarcoma, and the further assumption is then necessitated that sarcomas as a rule grow from isolated, or superfluous, or embryonal cell groups. Increasing observations of early sarcomas of inflammatory origin favor the view that sarcomas often arise from previously normal adult cells."

To quote from Ewing again, "Many sarcomas show such marked histological resemblance to inflammatory processes that pathologists have long been inclined to accept in a certain sense the inflammatory or even the parisitic origin of certain sarcomas."

Syphilis and tuberculosis are the most prominent infections which lead to sarcoma.

Case No. 1: H.C.A., colored, male, age 29 years.

When 2 years of age, fell from bed, striking spool of thread, making bruised spot beneath shoulders that remained faintly visible throughout seven years, but gave his parents no concern. At age of 8 years, noticed small lump where this blue spot had been, about size of hen's egg; consulted family doctor, who advised operation, which was performed in ninth year; diagnosis of lipoma was made, with no pathological examination. The scar remained unchanged throughout ten years.

At the age of 19 years he noticed small nodule, appearing at lower end of scar, which grew rapidly and in one year reached the size of an orange. He consulted his family doctor again, who advised another operation, which was done. The wound was large and healed by granulations; growth was diagnosed lipoma. No pathological examination was made.

Three years later, at age of 22, there was a recurrence of growth, and at the end of a year, it was about the size of an orange. He consulted a local doctor, who diagnosed the growth lipoma, and who, with the aid of a second doctor, removed the growth, and after removal made a diagnosis of sarcoma, with no pathological examination.

Two years later he came to me with a recurrence. I made a diagnosis of sarcoma, removed the growth; pathological examination was sarcoma, large spindle cell variety. Owing to wide dissection that I made, healing was slow. I did the operation in June and it was March before healing was complete.

In July, 1921, growth had recurred, was of immense size, weighing thirty-eight ounces after removal. Pathological examination showed large spindle cell sarcoma. I did a wide dissection, sacrificing a great deal of tissue, and turned him over to Dr. John S. Derr for x-ray treatments. He gave him massive doses of x-ray, five treatments of ten minutes each with intervals of five minutes between, each exposure

* Read at the 74th Annual Meeting of the Medical Association of Georgia, Savannah, May 4, 1923.

overlapping the other, covering the entire wound.

During first week of x-ray treatments he felt no effect, after which a violent itching and burning set up around the wound, which was treated with zinc oxide to allay the itching and burning. After six weeks, the burns were healed, he went back to Dr. Derr for further treatment and was given two treatments of ten minutes each, which left no sign of discomfort.

After one year and nine months the healed burnt surface remains the same. Healing at center of wound has been slow and is not yet entirely complete, although there is no apparent sign of recurrence.

The most striking characteristics of the growth from first to last are: absence of pain; rapidity of growth; absence of reasons for recurrence, as there were no bruises, licks or inflammations; negative to syphilis and to tuberculosis.

Case No. 2: E.K., colored, female, age 66 years, laundress.

Growth first appeared between the shoulders, about eight years ago, and was a small, soft, round nodule. I made diagnosis of lipoma and removed the growth, which was then about the size of a goose egg. Pathological examination showed sarcoma, small spindle cell variety.

The wound healed perfectly within a few days, but growth recurred again in one year, irregular in shape, multiple nodules, but forming one continuous mass. I did a second operation on January 26, 1921. Wound healed in a short time; pathological examination showed spindle cell sarcoma.

In a little over a year, it recurred and I removed it for the third time on April 4, 1923. Made wide dissection, removing the fascia, left the wound open to heal by granulations. The wound is now in process of healing.

There are no striking characteristics in this case, but what is exhibited in practically all cases of small spindle cell sarcomas, namely, lack of metastasis; low grade malignancy; firmness of tumor; slowness of necrosis or ulceration; negative to syphilis and to tuberculosis.

Case No. 3: M.D., colored, female, age 40 years.

Growth first appeared two years ago. In April, 1922, I removed the growth from between the shoulders. It was about the size of an orange, oval, soft and non-vascular. The pathological examination was lipoma.

Patient returned in February, 1923, with a recurrence of the growth in same scar between the shoulders, the growth being about the size of a goose egg and nodular. I removed the growth for the second time, it was nonvascular, firm and appeared to be muscle tissue. Pathological examination showed it to be small spindle cell sarcoma; negative to syphilis and to tuberculosis.

EDITORIAL

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Roentgen and Medicine

THE MEASURE of success in life as held up by the great Alexandre Dumas when he asked, "Will anything I have written live after me?" can be answered in the affirmative so so far as the late Conrad Roentgen is concerned. Although he was about fifty years of age when he discovered the x-rays, he lived to see his discovery reach an importance in the scientific and commercial world equal to the discovery of the microscope. Both of these additions to science mark an epoch in the advance of medicine.

Although Roentgen himself was not a physician, the x-rays were quickly applied to medicine. Within one week after the announcement of the discovery of the x-rays, Cox of Magill University, Montreal, successfully located a bullet which had been lodged in the leg of a patient for seven weeks. The following day the bullet was successfully extracted.

In England the first "x-ray photograph" was made January 16, 1896, by Campbell Swinton, using his own hand as a subject. The miniature apparatus used by him required twenty minutes exposure to produce this historic negative, which is still preserved in the museum of the Royal Photographic Society. In February, 1896, Porter, of University College, London, reduced the exposure time to four minutes by using a coil with a spark gap of three inches. The same month Swinton, using a ten inch coil at half capacity, made a successful radiogram of the human foot with an exposure of only fifty-five seconds.

The first radiogram made in England of a gunshot wound was made by Oliver Lodge, at Liverpool, and was recorded in the British Medical Journal February 22, 1896. In the same issue also appeared the first demonstration of a fracture of one of the finger bones done at St. Thomas' Hospital.

On January 27, 1896, at a meeting of the Paris *Academie des Sciences* MM. Lannelongue, Barthelemy and Oudin read a communication upon the utility of the x-rays in human pathology. They called attention to the fact that the x-rays could be used to reveal either an atrophy of bone or an overproduction of bone.

American physicians were quick to realize the value of x rays in medicine, so that almost immediately after the public announcement of their discovery American electrical engineers had apparatus ready for the physicians' use. Even in Omaha there were two x-ray equipments as early as 1898, the one in the office of the late Dr. Robert Jansen, and the other in the office of Dr. John P. Lord.

In 1898, while still a student at Harvard Medical School, W. B. Cannon employed powdered heavy metals to study the alimentary tract of laboratory animals, his observations being published in the American Journal of Physiology 6:251, 1901-02. In 1899, Dr. Francis H. Williams of Boston began the examination of the alimentary tract in human beings by means of the metallic opaque meal.

In 1905 Mr. Clyde Snook, an American electrical engineer, succeeded in producing a mechanical rectifying switch which made it possible to employ alternating current transformers in producing x-rays. Up to this time only direct current could be used, the capacity of the coil being limited by the inherent mechanical defects of the interrupters used in conjunction with them.

Following the invention of Mr. Snook, the tubes were the weakest link in the chain of advancement. But in 1913 this weakness was overcome by Prof. W. D. Coolidge, who then perfected the hot cathode type of x-ray tube which bears his name. These two fundamental improvements in apparatus made possible rapid advancement in the medical uses of the x-rays, both diagnostically and therapeutically.

But even before these improvements in apparatus much advance had been made. Mention need be made only of pyelography devised in 1906 by Voelcker and Lichtenberg and brought into common use by Braesch, 1910, of practical demonstration of gall stones by L. G. Cole, 1914, pneumoperitoneum by Jacobaeus, and of ventriculography by W. E. Dandy, 1918, to show the rapid advance in refined diagnosis by means of the x-ray.

Contrast the difference in the radiogram of the hand made by Swinton in 1896, requiring twenty minutes exposure and showing little or no detail, with the instantaneous radiograms made today of any part of the body, showing almost microscopic detail, and a faint idea of Roentgens' contribution to medicine will be had. In therapy, the contrast between the ten inch coil and the twenty inch modern transformer is equally great. To get a still stronger impression of the value of x-rays to medicine one need only ask the surgeon how he would like to practice surgery without the x-rays.

The present status of radiology, then, is due to the combined and cumulative effort of all the men mentioned as well as many others. This brings forcibly to mind the great debt medicine owes to the late Roentgen. Countless generations will revere his name as the great contributor to the betterment of suffering humanity. The constructive thought of the individual, coupled with co-operation of allied lines of endeavor, brings research to successful fruition.

Technicians

IT IS GENERALLY conceded by every radiologist that the technician is a necessary part of his personnel. In fact, the technician has become just as necessary to the radiologist as the nurse to the physician. Experience has proved that the trained nurse usually makes the best type of technician. In this particular role she plays a double part.

There has been considerable interest shown by various organizations during the past few years relative to giving the

technicians in radiology greater recognition, incidentally being thus able to raise the general standard of training for technicians. In this connection it would appear that each radiologist should become a teacher, teaching his own technician. A few suggestions may not be out of place relative to the information which should be imparted to every radiological technician.

It will be necessary, of course, for the technician to have training in the ethics of his or her profession. Where a graduate nurse is being employed she has already been given this instruction during her training at the hospital. Where a lay technician is used this subject will need to be given considerable stress so that the technician will grasp the fitness of things and recognize his relationship to the physician by whom he is employed, as well as to the patients with whom he comes in contact.

Technicians' training should cover several phases. The first phase would be instruction in the elementary principles of physics underlying the use of the instruments with which they must work each day. Instruction should be given in the electrical dangers connected with the instruments, dangers to the patient from high voltage shocks during the work; dangers to the workers with the instruments from high voltage shocks; a working knowledge of the particular machine which the technician is using should be given, as well as instruction in the fundamental principles underlying all x-ray power plants.

The second subject should be that of instruction in exposure technique, the various factors being shown and their influence upon good photographic results demonstrated. Special stress should be given to the subject of voltage, milliamperage, distance and time. The influence which each of these factors has upon photographic results should be explained, also special emphasis should be laid upon the inverse square law in relationship to distance.

Third, there should be instruction in dark room technique. Since ninety per cent of all trouble with x-ray photographic results is traceable to the dark room, it does not seem that this part of the training of the technician can be overemphasized. Specific stress should be put upon the matter of cleanliness in the dark room, together with the value of being over particular about the chemical processes employed. The influence of temperature on the developer should be stressed and the matter of time should be impressed upon the worker.

Fourth, should be the subject of positions, the technician being instructed carefully in the exact positions necessary to bring out the various anatomical features used in examination.

Fifth, the technician, of course, should be instructed in the formulas used for various types of opaque meals, opaque enemas, together with preparation of opaque solutions for demonstrating fistulous tracts.

Sixth, the technician should be well trained in the dangers incident to exposure of the body to x-ray so that she may know how to avoid x-ray burns on the patient and take proper care of herself. It has been the experience of most radiologists that graduate nurses who have some inclination toward mechanical things make better technicians. This type of technician is always anxious to do better work and is willing to co-operate with the radiologist in every possible manner.

It is imperative, then, that the radiologist should encourage the cooperative spirit amongst the technicians and that he should lay particular stress upon the desire of the technician herself to make higher standards. There have been numerous expressions from the technicians of a desire to bring this about and there is great opportunity for the radiologists of North America to cooperate with them in this regard.

It is a well known fact that physicians become better men by associating with each other in scientific societies and socially, and the same rule holds good with technicians, consequently, the radiologists of North America should encourage technicians in the holding of meetings where they may discuss problems which are of particular interest to them.

The Radiological Society has been active in the promotion of this spirit for several years and under the auspices of this society, the registration of technicians was instituted. This work is progressing nicely and is attracting considerable attention throughout the United States. It seems to the writer that the technicians would receive great benefit from a meeting held at the same time and place as the annual meeting of the Radiological Society.

Utah Society of Radiology and Physiotherapy

The following officers were elected at a recent meeting:

President. . . . . Mark Brown, M. D., Ogden
V.-Pres. Frederick Leaver Stauffer, M. D., Salt Lake City
Sec'y-Treas. . James Philip Kerby, M. D., Salt Lake City

The New England Roentgen Ray Society

At its last meeting this society elected the following officers:

President. . . . . P. F. Butler, M. D., Boston
Vice-Pres. . . . . W. A. LaField, M. D., Bridgeport, Conn.
Secretary-Treasurer. . . . A. S. MacMillan, M. D., Boston
Member Executive Comm. . . G. W. Holes, M. D., Boston

Dr. Clay E. Giffen

Telegraphic announcement of the untimely death by drowning of Dr. Clay E. Giffen, of Boulder, Colorado, comes as a distinct shock. Details are not available now, but autobiographical sketch will be printed in the September issue.

Dr. Giffen was a stalwart member of the Radiological Society and a painstaking radiologist. His sudden demise is a distinct loss, both to the Society and the profession.

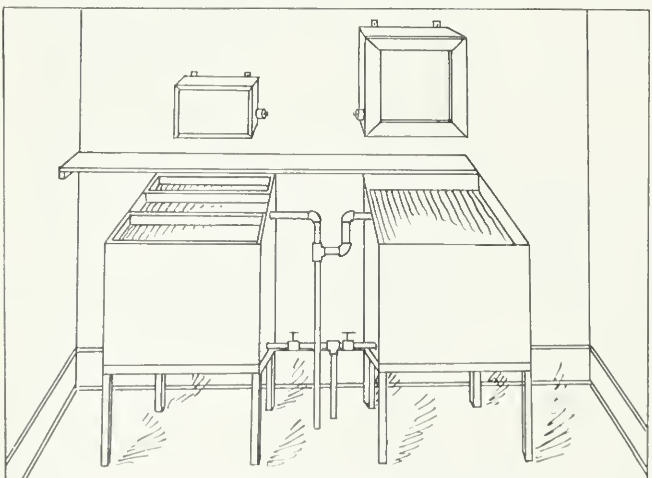
Hot Weather Fixation for Warm Weather Washing

E. G. C. WILLIAMS, M. D.
Danville, Illinois

HOT WEATHER brings dark room difficulties to the radiologists in towns drawing water supply from rivers or shallow lakes. If unlimited ice is available, the difficulty is easily surmounted, but if ice is scare or hard to obtain in office buildings, a system of fixation that will give good hard films with a minimum of ice is desirable. Several years of experimenting with various types of tanks and ice supplies have resulted in our using a simple system that requires less than fifty pounds of ice per day. This has been accomplished by separating our wash tank from the developing and fixing tank and in using a hardening fixation that prepares the emulsion for washing in water that often reaches 84 degrees. The two tanks as illustrated in the figure are best placed beside each other about eight inches from the wall to allow space for a safe light behind the first tank and a view box behind the second. Number 1 holds a 3-inch porcelain lined insert tank for developing and a 4¾-inch tank for fixing with a space for icing the water between the two. The hardening bath used has been selected from the many that have been tried because of its hot weather virtues. A stock solution of acid hardener is made in a five-gallon bottle or stone jar and one-half gallon is used each time the tank is filled. One filling is sufficient for at least 500 films. Materials for five gallons of hardener are:

Water . . . . 10 Qts.
Sodium Sulphite . . . . 5 Lbs.
28% Acetic Acid . . . . 6 Qts.
Powdered Potassium Alum . . . 5 Lbs.

Heat the sodium sulphite in six quarts of water. It will not dissolve but will form a milky suspension which settles rapidly unless stirred. Pour the suspension into the five-gallon bottle which contains two quarts of warm water to prevent breaking. Add the acetic acid by siphon through a rubber tube rotating the bottle to insure solution of the sulphite. When the acetic acid is all in, the sulphite will be in solution. Dissolve the alum in the remaining two quarts of water and add to the bottle while stirring constantly. Fill the bottle with water to the five-gallon mark. The result is a clear solution that will keep indefinitely.



To make five gallons of fixing bath, dissolve twelve pounds of Hypo in two gallons of water by heating or by standing 24 hours in four gallons of water. Pour the Hypo solution into the tank, add one-half gallon of the stock hardening solution and fill the tank to within one inch of the top. Stir thoroughly before using. As the level of the bath in the tank is lowered by use, add water or ice until the fixing time is definitely increased then make new bath. The solution as made is so concentrated that it will stand considerable diluting.

Cool the tank with broken ice to below 70 degrees. Leave films in the fixing bath for at least fifteen minutes, then they may be washed at a temperature of 83 degrees or more for fifteen minutes without injuring the emulsion, giving films that are clear and free from bloom. Washing should be accomplished as rapidly as possible without jets of water acually striking the films. Supply and over-flow pipes should be on the same side of the tank to insure complete circulation and rapid change of water. The water should run through the tank at a rate that would completely fill the tank in five minutes.

An insulation covering of asbestos or fiber board on the first tank will further help to maintain a low temperature and save ice. An insulated tank cooled in the morning will remain cool all day. The ice water compartment is washed out each morning before icing as the films are dipped into the ice water between developer and fixing bath.

NEW EQUIPMENT

Engeln X-Ray Fracture Unit

THE NEW Engeln X-Ray Fracture Unit, having a 30 ma. radiator tube, oil-immersed, is absolutely shock-proof from any high tension or live wires. The busy surgeon, reducing fractures or operating with the fluoroscope, can positively ignore any subconscious feeling that he must be careful of high tension wires. Any part of the apparatus can be touched, bumped or leaned against with complete safety. The surgeon and any of his assistants can work in closer co-operation than ever before possible when reducing fractures.

Although this new unit is spoken of as an x-ray fracture unit, it is especially adapted for locating foreign bodies, operating under the fluoroscope or for horizontal fluoroscopy. In addition, the 30 milliampere capacity of the apparatus with a full five inch back-up, permits its use for radiographic work.

The 30 ma. Coolidge radiator tube is entirely immersed in oil in the transformer box. This construction has been in use for several years at the Mayo Clinic, Harper Hospital and a number of other hospitals and clinics.

The aluminum table top has many distinctive advantages over any other kind. It can be easily cleaned and will not stain after reducing fractures or operating under the fluoroscope. The aluminum top can also be removed for thorough sterilization and polishing if necessary.

The table is 6 ft. 6 in. long, 30½ in. wide and 30¾ in. high, giving the surgeon ample and correct facilities for his work.

The transformer box with the 30 ma. radiator tube immersed in oil hangs under the table on a special double suspension roller-bearing carriage. Three point suspension is used to assure continual contact of all roller bearings and an easy sure movement of the transformer box. The transformer box with the tube inside can be moved over the entire length of the table and also across the table because of the double suspension. This is clearly shown in the illustration.

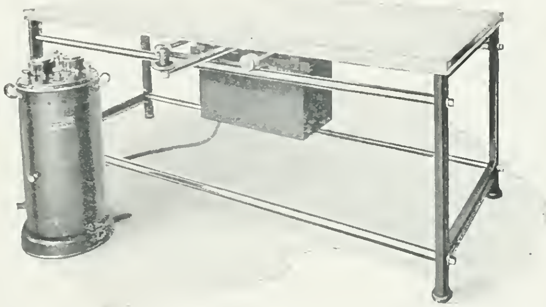
The motion of the transformer box with the oil-immersed radiator tube is controlled by the diaphragm shutter handle.

The Engeln shock-proof fracture unit control may be placed in any desired position. Your fluoroscopy can be controlled with the hand switch or the convenient foot switch. The control is equipped with a milliammeter; voltmeter, auto-transformer, adjustable for any spark gap up to 5 inches; magnetic filament control; main switch; and both hand x-ray switch and foot switch.

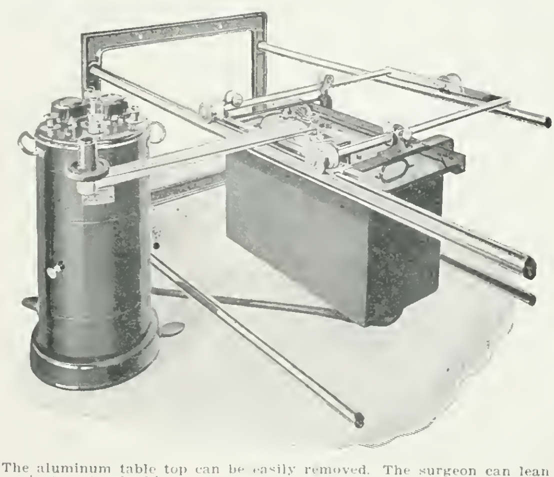
The convenient and practical arrangement of the meters and switches is clearly shown in the illustration.

The auto-transformer is controlled by the voltage selector for obtaining your spark gap. This switch is directly connected to an auxiliary switch which gives a working range of 90 volts in 48 steps on the voltmeter. In other words, a spark gap varying from 2½ in. to 6 in. can be obtained automatically by adjusting the voltage selector.

The entire apparatus is built of metal with a black satin finish and nickel trimmings. The apparatus is shock-proof—no live wires. Every surgeon in the country needs this apparatus, which fully protects him in reducing fractures or operating with the fluoroscope.



Illustrating the Engeln X-Ray Fracture Unit, separate control; transformer, x-ray tube and all high tension connections, immersed in oil in transformer box.



The aluminum table top can be easily removed. The surgeon can lean against or touch this apparatus with assured safety during its operation—it is shock-proof.

CASE REPORTS

Nevus Vasculosus (Strawberry Mark)

Report of a Case Cured by Radium Therapy

HAROLD SWANBERG, B. Sc., M. D.
Quincy, Illinois

OF the clinical types of angioma, the nevus vasculosus and angioma cavernosum respond most perfectly to radiation therapy. While either x-ray or radium can be used, the author's experience has been limited to the use of radium. Radium therapy is the method of choice of most dermatologists, the effect of the beta rays of radium being much superior to that of x-rays or gamma rays in nevus vasculosus. The following case of nevus vasculosus is reported and the photographs made before and after the radium treatment was completed, show the end-results that can be expected in the average case.

Baby M. C., two months old, was referred to me by Dr. C. A. Wells of Quincy. He was apparently a normal baby in every way, with a history of normal delivery. At birth a very small reddish area was present on the forehead on the right side just above the brow. This grew rapidly and when I first saw him was nearly oval in shape, 11 mm. in its greatest diameter, intense bright red in color, sharply circumscribed and raised about 1 mm. above the level of the surrounding skin. Radium therapy was immediately begun. The lesion was closely surrounded by a lead shield and a full strength radium plaque covered by 0.5 mm. of rubber was placed over the nevus. A six minute exposure was given every three weeks at first. The time factor was gradually increased to twenty-one minutes and the intervals to one month. It was found that a twenty-one minute exposure porduced a mild erythema, and the dosage was cut to seventeen minutes. Sixteen treatments were given in all, within one year's time.

Fig 1—Age two months. Nevus vasculosus on forehead.

Fig 2—Age 18 months, same case as Figure 1. Photograph taken four months after completion of radium treatment.

The photograph (Fig. 22) made four months after the last treatment shows the end result. The nevus has entirely disappeared and is replaced by fibrous tissue, being level with the surrounding skin.

MacKee in his recent work on, *X-Rays and Radium in the Treatment of Diseases of the Skin*, says: "The results of beta ray therapy in nevus vasculosus are so striking, so perfect, that they can be placed among the most notable achievements of radium therapy in the treatment of cutaneous affections." The author of this paper believes that physicians in general are not acquainted with the wonderful results of radium in these cases, hence this brief report. Such cases should be referred early for radium treatment (adult lesions are more recalcitrant than those in children) and thus save the parents months or years of unnecessary worry and anxiety.

ABSTRACTS and REVIEWS

The Cancer Control Problem. Edward H. Risley, M. D., J. Maine M. A. 13:218-229, April 1923.

CANCER control is possible, the author believes, and it can be attained in much less time than was taken to control pulmonary tuberculosis. The results attained by Dr. Bloodgood in Maryland prove that cancer can be controlled to a very great extent. The fact that the public has been put in a receptive frame of mind through the benefit derived from nation wide propaganda such as that against tuberculosis will make a similar campaign against cancer more easily achieved. There is no doubt that the intelligent public is steadily and increasingly demanding more of the medical profession in the way of enlightenment and aid to well-being.

Dr. Bloodgood has stated it as his opinion that education of the physician, dentist and layman will do more to control cancer than will any improvement in surgical or radiological technique. Since his personal efforts toward this sort of education in Maryland he has found "that the number of inoperable or hopeless cases coming to him for advice has been reduced from 48 per cent to 19 per cent: the number of operable and probably curable cases has increased from 3 per cent to 23 per cent and that the number of benign lesions seen has increased

from 3 per cent to 48 per cent or thereabout."

The educational campaign carried on in Maine for the past year has begun to show results in the number of early cases reporting for examination.

In Maine the work is directed by a committee of three, appointed by the State Medical Association, and another committee of nine, of whom three of the members are the three just mentioned. The others are the following individuals, a member of the State Board of Health, one from the Public Health Association, the head of the Maine Federation of Women's Clubs, the head of the Maine Nurses' Association, the head of the Maine Federation of Grangers, and the head of the Maine Federation of Labor.

The hopeful facts about cancer have been presented to a large number of lay audiences. A standard lecture was prepared and sent to every physician throughout the state. This lecture set forth the accepted and proven facts about malignant disease and was representative of the consensus of opinion of a large group of physicians of note rather than the opinion of any one man; this feature alone added greatly to the effectiveness of the campaign.

In addition to the general campaign special activities were carried on throughout cancer week. Lectures were given in theatres, churches and schools, before small groups of women everywhere in the state and in Portland before the employes of nearly all the large department stores. In one county the doctors coached their wives who then lent their aid in reading the lecture to groups and small audiences. Besides these lectures the newspapers published the standard lecture, and copies of the lecture and other literature were sent by R. F. D. to localities which could not be reached in any other way. In two years more Maine expects to have carried this educational effort to the point where no adult in the state is any longer ignorant of the most important facts which he should know about cancer.

There is also the phase of the problem as it applies to the physician. The importance of early diagnosis, of a complete physical examination, visual and digital, and the fatal results of procrastination must all be presented to physicians along with the facts pertinent to his understanding of cancer etiology, pathology and therapy.

The author feels very strongly that palliative treatment should be frankly stated to be such. If this is not done the inevitable fatal termination of the case will lead to erroneous opinions and conclusions on the part of the community and will react unfavorably upon cancer control.

In the discussion which followed this paper the main subject was the need of unprejudiced judgment and use of all available means of therapy. Surgery, x-ray, radium, and electrocoagulation as well, has each a proper place in cancer therapy and the wise specialist will not exclude any adjunct whose worth is as well attested as that of each one of these agents.

Diagnosis of Pyorrhea. Charles K. Field, D. D. S., Dental Facts, 2: 72, May 1923.

THE x-ray indication for pyorrhea may vary from a slight breaking down of the margin of the alveolar bone in the interproximal spaces to wholesale destruction of the cancellous bone surrounding the infected tooth.

Abscesses may be self-limited or diffuse and the latter are not so easily interpreted on the plate. With practice, however, a diffuse abscess can be recognized by a slight thinning of the alveolar process extending over a considerable area.

Rudyard Kipling on Research. The Lancet, 204:402-403, Feb. 24, 1923.

THE following excerpts are taken from an after-dinner speech made by Rudyard Kipling upon the occasion, last winter, of the celebration of John Hunter's birth. It is a beautifully worded tribute to medical research.

"There is a legend which has been transmitted to us from the remotest ages. It has entered into many brains and colored not a few creeds. It is this: Once upon a time, or rather at the very birth of time, when the Gods were so new that they had no names and Man was still damp from the clay of the pit whence he had been digged, Man claimed that he, too, was in some sort a deity. The Gods were as just in those days as they are now. They weighed his evidence and decided that Man's claim was good—that he was, in effect a divinity, and, as such, entitled to be freed from the trammels of mere brute instinct, to enjoy the consequence of his own acts. But the Gods sell everything at a price. Having conceded Man's claim, the legend goes that they came by stealth and stole away this godhead, with intent to hide it where Man should never find it again. But this was none so easy. If they hid it anywhere on Earth, the Gods foresaw that Man, the inveterate hunter—the father, you might say, of all hunters—would leave no stone upturned or wave unplumbed till he had recovered it. If they concealed it among themselves they feared that Man might in the end batter his way up even to the skies. And while they were all thus at a stand, the wisest of the Gods, who afterwards became the God, Brahm, said: 'I know. Give it to me!' and he closed his hand upon the tiny unstable light of Man's stolen godhood, and when that great hand opened again the light was gone. 'All is well,' said Brahm, 'I have hidden it where Man will never dream of looking for it. I have hidden it inside Man himself.' 'Yes, but whereabouts inside Man have you hidden it?' all the other Gods asked. 'Ah', said Brahm, 'that is my secret, and always will be unless and until Man discovers it for himself.'

"Thus, then, gentleman, does the case stand with Man up to the present * * * he might be defined as 'An imperfectly denatured animal intermittently subject to the unpredictable reactions of an unlocated spiritual area.'

"And it is just this search for this unlocated spiritual area, whether it be a growth or a survival, which has preoccupied Man from that day to this. The priest and the lawgiver have probed and fished for it all through the ages; but, more than any other, through all the ages, the leech, the medicine-man, the healer, has been hottest on its track. He has searched wherever he dared, openly or furtively, in safety or at the risk of his life. In the early days the astrologer-physician, as he called himself, dreamed that the secret of Man's eternal unrest was laid up in the sun, moon and stars; and consequently, since all created things were one in essence, that an universal medicament for Man's eternal woes would be discovered upon Earth. So he searched the earth and the heavens for those twin secrets, and sacrificed himself in the search as a matter of course. Later when the embargoes on the healing art were lifted * * * the nature of his dreams were changed for a while. He had found more wonders beneath his knife than earth or the planets had heretofore shown him. And that was barely ten generations ago. Once again * * he * * * renewed his search and once again sacrificed himself in the search as his passion drove him. There is no anesthesia so complete as Man's absorption in his own job.

"Man, the imperfectly denatured animal, who cannot trust the evidence of his own senses in the simplest matter of fact; whose evidence on the simplest matter is colored by his own iniquities; Man, always the hunter, went up against the darkness that cloaked him and every act of his being, to find out what order of created being he might be. He called it scientific research. It was the old quest under a new name. But, this time, the seekers who headed it, unlike the priest and the lawyer, admitted that they knew very little. Experience had taught them to be humble.

For that reason their knowledge was increased."

The editor of the *Lancet*, in his comment, says: "No sweeter or truer words could have been used to describe the leaders of scientific research. To probe, to question and to doubt have comprised their duty; but discharge of that duty, when faithful, has compelled them to be humble in the presence of the vast revelations which have followed."

The X-Ray in the Diagnosis of Pulmonary Tuberculosis. A Comparison of X-Ray and Physical Signs in 1000 Cases. Harry Lee Barnes, M. D., Am. Rev. Tuberculosis, 7: 202-206, May, 1923.

MORE than one thousand consecutive cases believed or suspected to have pulmonary tuberculosis were studied at the State Sanatorium at Wallum Lake, Rhode Island, and the following observations were made: "With rare exceptions, a negative x-ray in a positive sputum case means poor technique or inaccurate interpretation of the plates. Where suspicious physical signs are found at an apex and the x-ray is negative, it is best to restudy the plate, and when the x-ray shows densities in areas previously found free from physical signs it is wise to re-examine the lungs."

The author's summary reads as follows: "(1) Of 592 positive sputum cases only 5 were read as negative to the x-ray and rereading of the films showed that 4 of the 5 had slight changes at the apex. (2) Of 592 positive sputum cases, x-ray evidence of involvement of the second apex, unrevealed by physical examination, was shown in 6 per cent. (3) Of 592 positive sputum patients, in 380, or 64 per cent, the x-ray evidence of disease was more extensive than the physical signs; in 36 or 6 per cent, the physical signs were more extensive; and in 176 or 30 per cent the amount of lung involvement was about the same as indicated by the two methods. (4) Of 310 apices of negative sputum patients, in which dullness or moist rales had not been found, 40 per cent showed abnormal x-ray densities. (5) Of 728 apices of negative sputum patients, showing dullness or moist rales, 36 per cent were negative to the x-ray. (6) In negative sputum patients both dullness and rales were found in 40 per cent of the apices showing specks, 39 per cent of apices showing streaks and 30 per cent of apices showing haziness."

Prognosis in Tuberculosis of the Lungs from Examination by the X-Rays. A. Howard Pirie, M. D., Am. J. Roentgenol. 10:366-368, May, 1923.

THE author states that favorable prognosis is based upon absence of abundant mottling; presence of calcification in roots of lungs, and better still, in parenchyma of lungs; also in no diminution in the size of the heart.

Unfavorable prognosis is based upon abundant fluffy mottling; no calcification anywhere; diminution in size of heart. This diminution is out of proportion to that of other muscles.

Ten case reports are presented.

X-Ray Study of Tuberculous Lungs. Thompson Frazer, M. D., and John D. MacRae, M. D., New York M. J. & M. Rec. 117:34, Jan. 3, 1923.

IN considering the use of the x-rays in the diagnosis of chest infections, questions frequently asked are: (1) What is the value of x-rays in the diagnosis of tuberculosis? (2) Is it necessary that they be employed? (3) If not, why the necessary expense? (4) Do the x-rays supply any information not obtainable by other means? (5) Are the findings in accord with the physical examination? (6) If not, to which should the greater importance be attached? (7) Will the x-rays supersede other methods?

Rather definite answers can be given to these questions: (1) The x-ray is a procedure of inestimable value in tuberculosis. (2) In many cases, perhaps most cases, the other older methods will establish the diagnosis. (3) By the x-ray, one obtains a more complete clinical picture which fully justifies the extra expense. (4) Radiographs frequently disclose conditions not discoverable by other means. (5) The findings of physical examination and those shown by x-ray are frequently not in accord; usually the x-ray shows more pathology than would have been expected from the physical examination. (6) The information from radiographs should simply supplement the physical examination. (7) The x-rays will not, therefore, supplant the older methods. The roentgenologist should go as far as he can in describing his findings; he should make as much of a diagnosis and as much of a prognosis as he can, entirely from the x-ray findings. He should then consult with the clinician, and in conference make such changes in the final conclusions as may be indicated by the joint findings.

—W. WARNER WATKINS, M. D.

The Value of the Roentgenogram in the Diagnosis and Prognosis of Pulmonary Tuberculosis. Geo. G. Ornstein, M. D., New York M. J. & M. Rec. 117:19, Jan 3, 1923.

THE technique must be correct if correct interpretation is to be made. There must be a clear appreciation of the normal appearance of the lung shadows. Cole's pioneer work, dating back to 1908 still stands unquestioned. From a roentgen standpoint, tuberculosis of the lungs may be classified according to whether it involves the hilus, the bronchial trunks or the parenchyma, or any combination of these.

In hilus tuberculosis, there is something besides the normal picture, the hilus shadows extend out more or less in a diffuse manner, with a few calcified or fibrous tubercles. Other conditions may cause very similar shadows in this region.

In peribronchial tuberculosis there is a thickening of the bronchial trunk with tubercles to be seen here and there along its course; in places these may extend out into the parenchyma. This type is confined chiefly to the upper half of the lung.

If the parenchymatous type is present, there is little difficulty in seeing it; it is invariably confined to the upper half of the lung. When tubercles can be demonstrated in the parenchyma and are confined to the upper regions, tuberculosis may be confidently diagnosed. (*Note*: "Tubercle" is used here in the sense of Cole's description, as meaning a sufficient amount of tuberculous deposit to be seen grossly on the autopsy table).

The extent of the lesion may be best classified in the manner of Brown, Heise and Sampson: (1) Incipient or minimal—A total area of involvement not greater than to the upper level of the second chondro-sternal articulation on one side, or an intense pleuritic shadow. (2) Moderately advanced—Parenchymal involvement to the upper level of the fourth chondro-sternal joint of one side; or rarefaction cavities limited to one interspace; or scattered mottling greater than minimal but not greater than one entire lung; or the minimal area on both sides. (3) Far advanced—Greater areas than (2).

The pathological conditions from which tuberculosis need to be differentiated on the roentgenagram are pneumonoconiosis, syphilis, pulmonary abscess and various tumors of the lung.

The shadows in pneumonoconiosis are more uniform in density, have sharper margins, are larger in size and are more evenly distributed, extending out from the roots almost equally from both sides. The two conditions often exist together.

In syphilis of the lung, the lesions may be gummatous or interstitial; they attack the base of the lung usually. Gummata have a definite shape and

are invested with a dense capsule; the interstitial type is an intense fibrotic infiltration into the base, or an infiltration of all bronchial trunks throughout the lung.

Pulmonary abscesses and tumors can be differentiated from tuberculosis by the exercise of reasonable care and judgment in interpretation of shadows.

The determination of clinical activity is based on the character of the shadow cast by the tubercle as indicating whether it is firmly walled off, or whether the shadow indicates new formation.

Next in importance to the ability to determine clinical activity of the lesion is the importance of the roentgenogram in determining the prognosis.

—W. WARNER WATKINS, M. D.

Pneumonoconiosis: Reports of Cases. Alfred L. Gray, M. D. and J. Lloyd Tabb, M. D., Virginia M. Monthly, 49:647, Feb., 1923.

THE work of Jarvis, Pancoast and others has shown that the appearances on the roentgen plate are the result of reaction of the tissues to the presence of the foreign irritating material, rather than to actual accumulations of the dust material, except in the case of opaque materials; these may show as small, dense white spots distributed more or less generally throughout the lung.

The distinguishing characteristics whereby one may in most cases diagnose pneumonoconiosis are: (1) The more general distribution of the lesions throughout the lung. (2) Their similarity to each other in shape, density and general appearance. (3) Their existence in greater numbers in the lower portions of the lungs, especially the right. (4) The absence of clinical history indicating infection. (5) The absence from the sputa of characteristic bacteria. (6) The rapid disappearance of many of the roentgenographic appearances when the individual is for a short period removed from exposure to dust inhalations.

—W. WARNER WATKINS, M. D.

Osteochondritis Dissecans. Albert H. Freiberg, M. D., J. Bone and Joint Surg. 5:3, Jan., 1923.

OUR knowledge of this condition is due to the surgeon, Franz Koenig, who described the condition accurately in 1888, as follows:

"Those loose bodies which are formed in a joint, for the most part gravely diseased, stand in diametric contrast to such whose genesis is to be ascribed to an entirely circumscribed disease of the joint ends, which has been described as *osteochondritis dissecans.*

"Without any injury, there separate from the joint ends, fragments of varying size, in consequence of a process as yet unexplained; their bony surface becomes covered with a dense connective tissue containing cartilage cells, here and there. In the same manner the defect in the bone becomes smoothed over. In some cases a smaller body composed entirely of bone and smooth with the appearance of necrotic bone, lay under a larger piece perhaps two centimeters in diameter. These pieces often fitted almost exactly in the corresponding bone defect, seeming at times somewhat too large because the pits in the bone had become filled in. Aside from this, together with a fluid effusion and a slight villous hypertrophy, these joints looked perfectly sound and they remained to after the removal of the loose bodies."

The author reports four cases of the disease in the knee and one in an elbow. In all the x-ray findings were characteristic, in the knee the internal condyle of the femur showing a niche in the bone and loose body, the elbow showing a similar niche in the bone and loose body from the humerus. Traumatism is not regarded as a prime factor, the process seeming almost inevitably to be due to an infarction similar to that seen in other organs with terminal arteries. A concomitance of several elements seems necessary for this condition, namely, terminal arteries at this point; a long tubercle of the tibial spine; repeated small trauma in the position of flexion and outward rotation of the tibia on the femur.

Arthrotomy with removal of *all* the loose bodies is the only treatment.

—W. WARNER WATKINS, M. D.

Crush Fractures of the Spine. James O. Wallace, M. D., J. Bone and Joint Surgery, 5:28, Jan., 1923.

THIS is a study of 82 cases of fracture of the spine, a great majority of which had been unrecognized and untreated. In 67 of the cases there was a history of forcible flexion of the spine, from three types of injury: (1) Heavy object falling from above alighting on the patient, usually when the spine was slightly flexed; (2) Patient falling from a height striking on the head and shoulders; (3) Patient being caught between two objects causing slow forcible flexion of the spine. In the first group there were 45 cases, second group 17 cases and third group 5 cases.

In the 47 undiagnosed cases, the shortest elapsed time was 25 days and the longest 1045 days. In 23 cases there were other fractures outside of the spine. Fracture of the transverse process was the most common injury; fracture of the spinous process occurred in only three cases and of the articular processes in one case.

With regard to pain, there are records in only 60 cases. Of these 30 had back pain and referred pain; 20 had back pain alone; four had referred pain only and six had no pain at all. With regard to other complaints, 23 had paralysis or weakness of legs; loss of bowel or bladder control in 8 cases; sensory disturbances in 4 cases; weak back in 16 cases; stiff back in 13 cases; inability to straighten back in 8 cases; inability to lift in 6 cases; shortness of breath in 3 cases; loss of sexual power in 3 cases; nervousness in 3 cases.

With regard to deformity, there is record in 58 cases, and there was deformity in 46 of these.

In 34 cases out of 81 there was dislocation of the vertebra.

All cases had some limitation of motion.

Paralysis was present in 23 cases out of 78.

With regard to location in the majority of cases, only one vertebra was involved. The series contains instances of fracture of all vertebrae except the first and second cervical, sixth cervical, and first dorsal, the first lumbar being most frequently injured (33 times).

In studying the radiographs it was seen that in most cases the vertebra above was driven against the one below, the latter being crushed, but in 20 per cent of the cases the reverse action occurred, the vertebra above being crushed .

—W. WARNER WATKINS, M. D.

The Bacteriology of Irradiated Tonsils. H. J. Ullman, M. D. and F. R. Nuzum, M. D., Am. J. Roentgenol. 10:396-398, May, 1923.

THE authors state that of 20 cases receiving roentgen irradiation of the tonsils 20 per cent underwent a marked gross change, became much smaller, and remained free from what the authors refer to as beta hemolytic streptococci (colony having a zone of complete hemolysis immediately about the colony varying from 1 to 4 mm. in width). An additional 35 per cent became free from the beta cocci for about six months and 45 still harbored these organisms during the entire series of exposures. No relation was observed between clinical and bacteriological results. Conclusions cannot yet be drawn from this study but a further study and report is contemplated.

The X-Ray Treatment of Tonsils and Adenoids. J. D. Southard, M. D., F. A. C. S., J. Arkansas M. A., 18:130, Dec., 1922.

THE author has been using this treatment for more than a year and while his experience has not been large, it consists of a sufficient number of cases to assure him of its efficacy in children and adults.

His average technique is a seven or eight inch spark gap, 14 ma. min. at ten inch distance and 2 mm. Al. The rays pass underneath and internally to the lower maxilla, first from the front and then from behind. The same skin area is not covered oftener than once every two or three weeks. Eight to ten treatments to each tonsil is usually sufficient.

—W. WARNER WATKINS, M. D.

The Present Status of Radiation Treatment of the Tonsils. Carl F. Robinson, M. D., New York M. J. & Med. Rec., 117:39, Jan., 1923.

THIS author reports results upon a series of 156 cases treated with radium, in 145 of whom, six weeks after the radium application, only a small atrophied tonsil could be seen by pushing back the anterior pillar. Five cases only were unsatisfactory, the tonsil being fibrous and radiation therefore not suitable.

The technique is to bury two 12.5 mg. needles into the center of each tonsil under local anesthesia, leaving them in place from two to three hours.

References to the use of radium in treating tonsils are reviewed, and the fallacy of the claim that radiation treatment of tonsils will injure structures in the neck is shown.

It is possible to apply radium externally, using the same general principles as in the use of the x-ray. This is particularly applicable to children, where it is difficult to treat them by x-ray. However, the method of choice with the author is to bury radium needles in the tonsils and supplement this by x-ray, if necessary.

—W. WARNER WATKINS, M. D.

A Study of the Tonsil Question with a Preliminary Report of Roentgen Ray and Radium Therapy in the Treatment of Pathologic Tonsils. Laura A. Lane, M. D., F. A. C. S., Minnesota Med., 6:97, Feb., 1923.

THE tonsil question is still one of the most discussed in medicine. Too little attention has been paid to the after results of tonsillectomy and too many operations are done without securing permanent results.

A report from Johns Hopkins Hospital, based on 1000 cases examined before operation and from one to four years after operation, is very illuminating: 58 per cent showed mouth breathing after operation; 55 per cent showed evidences of tissue left after operation; 40 per cent of operated patients were just as liable to sore throat after operation as before, the angina often being more diffuse.

Tonsillectomy is rarely of benefit in deforming arthritis, never in acute chorea, rarely in acute rheumatic fever, endocarditis, and chronic kidney lesion.

Treatment must look to the removal of the cause of the tonsil disease. Cleaning up a badly infected mouth is absolutely essential before instituting any form of treatment.

Patients with the following tonsil conditions should be operated unless presenting a serious heart, pulmonary, or grave physical contraindicating condition: (1) History of repeated attacks of tonsillitis and peritonsillar abscess. (2) Small, firm, sclerosed, submerged tonsils with frequent sore throats. (3) Badly diseased and abscessed tonsils causing acute polyarthritis, acute kidney lesion, certain eye lesions or other definite evidences of focal infection. (4) Cases of rapidly increasing deafness and ear infection due clearly to diseased tonsils and adenoids.

During the year ending September, 1922, the author has had under treatment and followed up, 52 patients treated with roentgen ray and 24 treated with radium or both combined. The results to date have been very satisfactory. The author's conclusions, drawn from literature and personal experience, are: (1) Study of more than 30,000 patients from various sources one to four years after operation shows permanent results in only about one-half of the total number. ((2) The tonsil has a function and greater care should be taken to preserve this, especially in childhood. (3) Greater care is necessary in studying patients with tonsil disease and in selecting patients for operation. (4) Roentgen ray and radium offer a safe method of treatment in carefully selected cases. (5) Results in children and adults have been most striking in cases of a decided lymphoid hyperplasia type; also in patients with cervical adenitis associated with tonsil pathology. (6) Longer study is needed to prove the permanent disappearance of all symptoms accompanying tonsil and adenoid disease, and some further investigation on the types of tonsils best suited to this form of therapy is also needed.

A very complete bibliography accompanies this paper.

—W. WARNER WATKINS, M. D.

The Blood with Deep Roentgen Ray Therapy. Edwin M. Hirsch, M. D. and A. J. Petersen, M. D., J. A. M. A., 80:1505, May 26, 1923.

FROM a chemical study of the blood of patients treated in the routine way with high voltage x-rays the authors found "no striking or consistent alteration in the urea nitrogen, the total non-protein nitrogen, the uric acid, the creatinin or the sugar concentration * * * There is, however, a disturbance of the acid-base equilibrium, manifested immediately after treatment by an increase of the hydrogen-ion concentration, and an increased alkali reserve." After twenty-four hours these relationships are reversed.

Leukemia, with Observations on the Treatment and Findings. Emmett L. Irwin, M. D., New Orleans M. & S. J. 75:366, Jan., 1923.

THE following definition of leukemia is quoted from Ordway and Gorham: "Leukemia is a disease of the blood-forming tissues which produce leukocytes, manifesting itself by a marked hyperplasia of these tissues, characterized clinically by a remarkable increase in the number of white cells in the blood, and by varying grades of splenic and glandular enlargement. The leukemic white blood corpuscles vary from the normal leukocyte in many instances and are pathologic unripe cells gaining entrance into the blood before maturity."

Depending upon whether the myeloid or lymphoid tissue has become stimulated to a state of hyperplasia, we have myelogenous or lymphatic leukemia. Both forms have a tendency to run a chronic course, but either may occur in an acute and rapidly fatal form.

The cause has not been determined. The onset is gradual and is usually discovered late, the patient usually seeking advice for lassitude, progressive enlargement of the abdomen, dyspnea, or a mass in the abdomen; others seek advice on account of weakness, loss of weight, gastro-intestinal disturbances, dizziness, or hemorrhage from nose or bowel. The red cells and hemoglobin diminish as the disease progresses.

There are today only three recognized measures which have any effect upon the course of the disease, namely, benzol, radium and x-ray. The latter are preferred, and benzol should be used only on those patients who do not have access to radiotherapy. It is not believed that splenectomy is justified, but if performed, it should be done after radium and x-ray have reduced the size of the spleen. While the use of x-ray and radium are the best methods available today, these are only palliative, lengthening the patient's life, but not permanently curing him.

—W. WARNER WATKINS, M. D.

Roentgenologic Aspect of Chronic Appendicitis. Henry K. Pancoast, M. D., Arch. Surg. 6:85-88, Jan., 1923.

THE value of an x-ray examination in appendicitis is discussed under five headings: (1) congenital anomalies; (2) data obtainable from observation of the visualized appendix; (3) abnormal appearances in other structures; (4) the finding of some other condition accompanying appendicitis and requiring further surgical exploration; (5) the exclusion of any other surgical condition than a diseased appendix.

Only rarely is it either wise or necessary to submit a case of acute appendicitis to an x-ray gastro-intestinal examination.

Under the first heading is cited congenital transposition of the viscera, the cecum and appendix being found upon the left side in such cases; failure of complete rotation of the cecum is also noted.

Under the second heading the author states that the appendix cannot always be visualized. Neither visualization nor the lack of it is necessarily indicative of disease. There is lack of agreement regarding the relation between diseases and irregular filling. Study of the visualized structure must be mainly fluoroscopic and plates when made should be made under fluoroscopic control. Adhesions must be determined by the palpating spoon. A kink that cannot be straightened, or that recurs after straightening, is good evidence of adhesions. If the opaque contents remain after they have left the cecum poor drainage is inferred, though this does not necessarily mean pathology is present. The author says, "Whenever a retrocecal appendix is suspected because of its absence elsewhere and the evidence of adhesions or continued tenderness over the cecum, it is wise to continue the examination until the latter is empty." The significance of the finding of a retrocecal appendix must be considered jointly with the surgeon and the clinician.

Under the third heading it is stated that the appendix can be diseased without any manifestation anywhere. Adhesions, especially in connection with the terminal ileum, are most important. A kinked terminal ileum or one adherent to the cecum is probably due to a diseased appendix, providing no inflammatory pelvic disease is present. Iliac stasis is not reliable as a diagnostic sign. Definite pyloric spasm is a very suspicious sign though the cause may be a diseased gall-bladder or gall stones.

Under the fourth head ureteral stone is named as the most frequent finding, after which comes gall-bladder disease, gastric and duodenal ulcer in the upper abdomen, diverticulitis of the colon, inflamed Meckel's diverticulum, early malignancy of the bowel, tuberculosis of the cecum and spinal disease. Ovarian and tubal disease or etopic pregnancy are all beyond the power of x-ray diagnosis as a rule.

Fluoroscopic examination of the chest should be made a routine part of gastro-intestinal study. An adherent or restricted diaphragm due to a previous pneumonia has been found at times to account for abdominal symptoms.

"It would be too great a burden for the roentgenologist to make a routine gastro-intestinal study in every case of appendicitis unless his work was largely confined to that particular field. If, however, the symptomatology is in the least obscure or some other condition is suspected elsewhere in addition, a complete study is likely to justify the surgeon in limiting his exploration to the region of the appendix if no other condition is found, or to direct him to the proper field if a co-existing surgical condition is demonstrated."

Enteroliths. W. W. Boardman, M. D. Am. J. Roentgenol. 10:369-373, May, 1923.

Acute and chronic gastro-intestinal disturbances whose etiology is baffling have at times been demonstrated to be due to enteroliths. Although these are rare their possibility should be kept in mind and careful physical and x-ray studies made to determine whether they are the cause of the disease symptoms. The author states that in all obscure gastro-intestinal cases a thorough exploration should precede operative measures. He reports a very interesting case in his practice in which an enterolith was finally discovered. Mechanically it had acted as a ball valve, carried toward the recto-sigmoid junction it occluded the lumen of the bowel, carried back into the dilated curve of the sigmoid there occurred expulsion of gas and fecal matter. Thus the alternating periods and diarrhea were explained.

Enteroliths are of three kinds: hard, mostly composed of phosphates and carbonates and averaging two to three centimeters in diameter but occasionally much larger; soft enteroliths composed of indigestible fibers and membranes with a small amount of organic material, the so-called oatstone of Scotland belongs to this variety; lastly, the very rare enteroliths which follow the administration of mineral drugs.

Enteroliths are more frequently found in the large bowel than in the small one and may exist for years without causing any untoward symptom.

Even when they are of sufficient density to be revealed by the x-ray they may escape detection if a plate is not taken before the administration of the barium meal. Especially with the double meal technique, barium may obscure an enterolith in the sigmoid or the pelvic colon.

The routine barium meal may reveal the presence of an enterolith by a dilated and elongated section of the bowel, by a filling defect as a result of the varying densities of the enterolith and the barium, or if the meal be completely followed, by an intensification of the shadow cast by the adhesion of barium to the surface of the enterolith. Less definite findings will be given in the small bowel, the shadow resultant upon adherence of barium will be the most likely thing to reveal the enterolith's presence.

Peptic Ulcer with Deformities of the Viscus, Evidenced by X-Rays, Changed for the Better by Treatment. Max Einhorn, M. D., New York M. J. & M. Rec. 116:613. Dec. 6, 1922.

THIS paper attempts to answer the doubts of the surgeon regarding the efficacy of medical treatment of peptic ulcer, this doubt being expressed by Sir Berkeley Moynihan as follows: "We ask for a series of cases in which the physician, the surgeon and the radiographer are agreed that a gastric ulcer is present, in which medical treatment has been tried, in which all are confident that a healing of the ulcer has taken place, and that the healed ulcer has not again broken down * * * At present, I do not know of any such evidence I can accept."

A series of twelve cases is given, five being penetrating callous ulcers of the lesser curvature of the stomach, one a penetrating ulcer of the pylorus and six clear cut cases of duodenal ulcer with constant deformities of the cap. These cases were examined and treated between April, 1921, and April, 1922, the radiographic work being done by Dr. Wm. H. Stewart and Dr. H. A. Rafsky, before and after treatment.

They were all benefited by the duodenal alimentation treatment; there was a change for the better in the pathologic findings as revealed by the x-rays, the niche formation having entirely or almost entirely disappeared and the cap deformities likewise changing to almost normal conditions.

Based on these experiences, the author concludes that as a general rule, most varieties of the peptic ulcer, even the graver forms, are amenable to medical treatment.

—W. WARNER WATKINS, M. D.

The Roentgen Therapy of Tinnitus Aurium. Lyell Cary Kinney, M. D., Am. J. Roentgenol. 10:378-379, May, 1923.

FOURTEEN cases of tinnitis from chronic otitis media were treated by small doses of x-ray. The dose delivered was calculated to deliver approximately one-half of an erythema to both ears in one month: the factors of dosage were 135 kv., 5 ma., 6mm. Al, distance 60 cm., portal 5 cm. diameter. Two minutes were given on each side daily for eight doses with a weekly interval of rest. Each case received three such series and if no improvement was then apparent the treatment was abandoned.

If the tinnitis is the symptom of otosclerosis, prevention of increase is all that may be looked for and that only in early cases. If chronic otitis media is the cause of tinnitis relief may be expected. Improvement is due to anatomical changes and not to endocrine stimulation, the author believes. The x-ray is only an adjunct in treatment of tinnitis.

The Value of the Roentgen Study of Mastoid Disease in Children Under Five. Wm. A. Evans, M. D., Am. J. Roentgenol. 10: 382-385, May, 1923.

THE author disagrees with the authorities who claim that the pneumatization of the mastoid does not, except in rare cases, occur before three years of age. His findings in 7 cases less than one year of age, 46 less than five years of age, and 52 between the ages of five and ten revealed the following facts: (1) Pneumatic mastoid structure is frequently observed before the end of the first year of life. (2) The adult mastoid structure can be observed as early as the second year. (3) Stereo plates of good quality, of children under five, have definite diagnostic and prognostic value.

Roentgen Therapy of Acute Infections of the Antrum and Frontal Sinus. John D. Osmond, M D., Am. J. Roentgenol. 10:374-376, May, 1923.

THIS paper reports the x-ray treatment of twelve cases of acute inflammation of the frontal sinus and antrum. Application of the ray was coincident with the relief symptoms, though as yet the author does not draw any definite conclusion as to the part played by the x-rays in bringing this about.

He issues these warnings to those who may try this form of treatment in a purulent sinusitis: First, the eyes must be protected from the rays: second, the rays can be of no use in chronic conditions, and third, if pent up pus is present septicemia may result if treatment is instituted.

A Few Points in Radio-Therapeutic Technique of the Face and Mouth. Walter A. Weed, M. D., Southern M. J. 16:102, Feb., 1923.

AFTER the question of diagnosis, the indication for treatment, and the dosage have been determined, the predominant factor in the successful use of radium and x-ray is the technique of the mechanical application. Radiologists must work with the same precision and care as the most exacting surgeon does in the mechanics of surgery, before results will be uniform.

In lesions about the face and mouth, each case is an individual mechanical problem, but practically all cases will result satisfactorily, if the proper care is given to the mechanics of each. In basal cell lesions, the choice between x-ray and radium is largely one of convenience. Where there is considerable tumor formation, removal by thermo-coagulation preliminary to the use of x-ray or radium has been most satisfactory. The use of two series of needles connected by wires, the two poles of the high frequency current being brought into contact with the two sets, thus coagulating the entire mass is recommended.

—W. WARNER WATKINS, M. D.

The Use of Radium in the Treatment of Benign Hypertrophy of the Prostate. Warren A. Dennis, M. D., F. A. C. S., Minnesota Med. 6:9, Jan., 1923.

THIS author reports the use of radium by imbedding needles on the prostatic tissue, after the method of Barringer, for benign hypertrophy, with exceedingly encouraging results. Slight variations in technique were used, aiming to avoid a necrosis of tissue as was produced in his first case. From 300 to 400 milligram hours may be safely given at one sitting, and it seems to be better to use 25 mg. in one lobe than to split this between the lobes. The needles should be introduced first into the deepest portion of the gland on account of the shrinkage and fibrous tissue formation.

The placing of the needles is painless and there should be no discomfort if the urethra is not penetrated.

With the patient in the lithotomy position, a single wheal of local anesthetic is made in the skin of the perineum halfway between the anus and the scrotum. With the finger in the rectum as a guide, the tissues between the skin and the anterior surfaces of the two lobes are then infiltrated and an incision 0.5 cm. long made in the skin. The needles are then inserted along the infiltrated tract into the substance of the prostate.

—W. WARNER WATKINS, M. D.

Remarks on Pyelography at a Lantern Demonstration before the Congress of Radiology and Physiotherapy. Sir John Thompson Walker, M. D., Arch. Radiol. & Electroth. 27:334-343, April, 1923.

AT a certain period in the history of hydronephrosis the kidney cannot be felt by palpation. At this period the distention is moderate, tissue destruction is slight and there is no infection. The complaint will usually be of recurrent abdominal pain. Pyelography becomes necessary if there is failure to find a movable kidney or stone in the pelvis, or infection. Fully developed hydronephrosis can be diagnosed without pyelography.

The solutions at first used for this procedure, collargol and thorium nitrate, have proved unsuitable for the purpose and at present sodium bromide or sodium iodide is being used. The author uses sodium bromide, as it is cheap, unchanged by boiling, and is clean. It should not, however, be used in a greater than 20 per cent solution as it produces irritation.

All retained fluids must be withdrawn by the catheter before injection is done and injection should be halted as soon as pain is felt. The catheters used should be of moderate size to allow escape of fluid along the sides (a precaution against overfilling the renal pelvis). The catheter is passed until arrested and then is withdrawn about one centimeter; otherwise, upon entering the upper calyx this will be distended and pain will be felt before the renal pelvis is filled. The patient lies with the head low as this position assists retention of fluid. It is very important that plates and tubes be in position for instant action since slight delay often leads to failure, and is dangerous in any case. There must also be provision for exposure of additional plates without delay in case these may be needed. Fluid should be removed at once after exposure. If first plates are unsatisfactory another injection is then made.

Previous experience in catheterization is necessary to the operator; the "occasional dabbler" has no place here and the novice in pyelography will be wise to make use of hydrostatic pressure as a guide in injecting the fluid. This is the best safeguard against overdistention and only the experienced operator is really safe without it. It should

be remembered that as hydronephrosis advances the pain of distention diminishes, and there are some patients who have strangely insensitive renal pelves.

The essential points in reading a pyelographic plate are five: "(1) The normal pelvis is trumpet shaped and is set vertically on the upper end of the ureter, and from it the calices project laterally and antero-posteriorly. (2) The normal calyx has a short neck and expanded end, which is cup-shaped. In the hollow of the cup lies the apex of the pyramid. Calices seen end-on appear as rounded, darker patches near the outer border of the shadow of the pelvis. Usually most of the calices are seen projecting laterally. Occasionally a number of end-on calices are shown and they may resemble stone shadows. (3) An opaque catheter passes from the ureter vertically, or with a slight outward curve into the upper calyx. (4) The upper ureter, the lower margin of the renal pelvis, and the lowest calyx, form a symmetrical curve amounting to half a circle, which I have named the uretero-calicine curve. (5) The expansion of the ureter into the renal pelvis is gradual and there is nothing to mark the point of junction."

Regarding changes due to obstruction: (1) The earliest changes in the development of hydronephrosis are in the calices. The cup end of a calyx becomes rounded or club-shaped, so that the cupping disappears. The neck is shortened and broadened. In the advanced hydronephrosis the calices are represented by rounded bays. (2) The pelvis becomes rounded, sometimes square, upper margin elevated, lower margin depressed, however, the over distended renal pelvis has a rounded appearance that the trained eye quickly detects, the untrained must not mistake it for early hydronephrosis. (3) Ureter-calicine curve becomes an angle and gradually disappears. (4) Upper wall of the pelvis pushes upward and line of ureter and upper calyx is changed. The catheter will no longer enter the calyx but pushes the roof of the pelvis up like a tentpole, or catheter may coil into a loop. (5) There are also changes at the junction of the pelvis and ureter, lumen is narrowed, or angle of joining is altered. There may be a kink at the upper end of the ureter, if temporary it will be affected by position, if permanent it will be unaffected by either erect or horizontal position.

In speaking of other uses of pyelography the author says that usually a plate of good quality will suffice to localize a supposed stone shadow. It must be remembered that a small stone frequently moves from calyx to calyx. Every kidney stone is either in the pelvis on in the calyx. In doubtful cases pyelography may be resorted to to demonstrate the exact position of the pelvis and calices and hence differentiate between renal and gall stones. This may also be accomplished by lateral radiography and pyelography.

Regarding lateral radiography the author says: "The ureter * * * reaches the anterior margin of the bodies of the vertebrae at the level of the fourth lumbar vertebra. The shadow of a stone in the pelvis, or in one of the calices, lies on the shadow of the vertebra. Where the stone lies at the extremity of a calyx, near the surface of the kidney, the shadow may lie behind the body of the vertebra. Where the stone is of great size, or there is a collection of stones with a much enlarged kidney, the shadow or shadows project beyond the anterior margin of the bodies of the vertebrae. With these exceptions the stone shadow will be found on the shadow of the vertebra body.

"With improved modern technique, gall stones are frequently shown on the x-ray plate, and the shadow or shadows lie in the right renal area of an anteroposterior radiogram. With a lateral view the gall stone shadows lie well in front of the bodies of the vertebrae and are usually lower down, apart from the character of the shadows."

Cancer of the Urinary Bladder Cured by Radium. Curtis Burnam, M. D. and George Walker, M. D., J. A. M. A. 80:1669, June 9, 1923.

THIS paper reports an infiltrating bladder cancer which was treated by transabdominal radium radiations and which has remained healed until the present writing, seven years after treatment. The authors conclude their paper with this summary: "The inference from this case, and it does not stand alone, is that in the treatment of cancer of the bladder the employment of gamma radiation from the exterior of the body is very valuable. It is also susceptible of wide application, as it can be combined with surgical operation and with topical application of radium, as well as with implantation of bare emanation tubes. It is possible, if adequate radium is available and proper use is made of it, to bring any desired amount of radiation to any part of the bladder without serious injury to the skin."

Cancer of the Cervix Uteri. J. L. Faure, M. D., Presse med. 31:461-463, May, 1923.

RADIUM is advised in all inoperable cases. Here its value as a palliative is proved and besides there is always a chance that an inoperable case may be rendered operable under radium treatment. If one is doubtful whether a case is operable, the author would use radium, but he would operate in all cases where he believed it at all possible. In all cases other than the inoperable and the doubtful ones he advises operation providing the surgeon's experience has made him both skillful and speedy, otherwise radium is held the better treatment.

The author's experience with radium has not been altogether satisfactory. After a very remarkable recovery following radium application in a hopeless case he felt a great confidence in its efficacy and throughout the years 1910 to 1920 he used postoperative radium treatment in this type of cancer case, but when he found that time proved the percentage of recurrence slightly higher in the cases postoperatively treated than in those not so treated he changed his mind and discontinued postoperative treatments. He cites statistics from many gynecologists of various countries, claiming most excellent results from radium treatment, but he doubts them all. Dr. H. A. Kelly's sincerity and integrity he does not question but he believes that Dr. Kelly is deceived and that time will prove his present percentage of cures to be wrong. However, the author states that he himself may be mistaken and that the present technique, given time to prove itself, may induce him to change his own mind a few years hence.

Dr. Faure believes that the speed of the operation has a great deal to do with the results. The chance of recurrence increases with the length of time taken to do the operation; no operation should take longer than an hour, and an operation lasting longer than two hours he regards as a hopeless effort, because recurrence will be certain. This belief is strengthened by his observations of results obtained by operators whose skill is equal in all points except that of speed.

Radiation in the Treatment of Menorrhagia. D. A. Rinehart, M. D. J. Arkansas M. A. 19:175, Feb., 1923.

WHEN due to the following causes radiation is indicated for menorrhagia: Endometritis of various forms; fibromyomata of the uterus; and a third group in which there is no demonstrable pathology within the uterus and in which the symptoms are believed to be due to ovarian hyperfunction. Menorrhagia from all these causes occurs in all ages and in all types of patients.

If all palliative measures have failed to relieve a menorrhagia due to a non-

infective endometritis or ovarian dysfunction and occurring before the age of 35, it can be successfully controlled by the use of radium or x-ray. Ten years ago hysterectomy would have been employed.

Radiation is preferable to surgery in menorrhagia of severe degree caused by endometritis or ovarian dysfunction in young women, radium being preferred to x-ray if no infection is present. Radiation is indicated in all small and medium sized fibroid tumors of the uterus in all ages where operative relief would require hysterectomy. In young women surgery is indicated where myomectomy is possible, in fibroids of large size, in those that are pedunculated and those that have undergone degeneration.

Personal experience covers 93 cases with one unsuccessful result where operation showed a fibrous mass behind the uterus in addition to the fibroid, this mass containing placental tissue traceable to a ruptured ectopic pregnancy seven years earlier.

—W. WARNER WATKINS, M. D.

A Review of the Treatment of Hyperthyroidism by All Methods, with a Summary of the Authors' Experience with Roentgen Therapy. Thos. A. Grover, M. D., A. C. Christie, M. D., E. A. Merritt, M. D. Am. J. Roentgenol. 10:385-393, May, 1923.

THIS paper briefly reviews the history of the treatment of hyperthyroidism from the beginning and discusses present day methods fully. Statistics are quoted from the Mayo Clinic and from Crile.

The surgeons' objection that there is no proof of cure by roentgenotherapy is met with the statement that roentgenotherapy of hyperthyroidism is still in its infancy for only since 1915 has anything like uniform treatment been agreed upon; surgery has had forty years of trial and in 1900 was in about the same situation with respect to medical treatment that roentgenotherapy is now in with respect to surgery.

The surgeons' objection that further and irreparable damage will be done the system during the time consumed by roentgen therapy, the authors do not believe is valid, because if roentgen therapy improves the case improvement will be apparent within a month and if not then surgery may be resorted to. If no longer period than this elapses operation will be more easily accomplished than it would have been without roentgen treatment, since the vascularity will be reduced by the rays. If kept within these bounds there will be no room for the objection that the difficulty of operation is increased by previous roentgen therapy. Neither is the objection that roentgen treatment may produce hypothyroidism a valid objection. If there is any danger of this at all, it can be avoided by using the basal metabolic rate control.

The authors have treated 114 cases of hyperthyroidism and sufficient time has passed to establish the clinical cure of 32 of these, 24 are greatly improved and in general the results are satisfactory.

Their method is to give treatment over each lobe of the thyroid and over one area of the thymus region. Essentials are 5 ma., 9 inch gap, 8 inch distance, 5mm. Al for six minutes. Three successive doses are given at three week intervals and the basal metabolic rate is again determined three weeks after the third treatment. A fourth treatment is usually found necessary. Thereafter treatment is at monthly intervals until, at the most, three or more have been given.

General management and treatment of patient is decidedly stressed as an important factor.

The authors conclude that "Comparison of the results obtained in treatment of hyperthyroidism by surgery and the roentgen ray indicates that these two methods are probably about equal in the percentage of permanent cures.

"Patients with hyperthyroidism should first receive roentgen treatment, and thyroidectomy only if they fail to respond to this treatment.

"The general management of patients with hyperthyroidism is of prime importance whether the ultimate theatment is to be roentgen ray or surgery."

The Value of Anti-Cancer Campaigns. Editorial, World's Health (Red Cross) 4:24-26, April, 1923.

THIS editorial contains an interesting summary of the work being done in various countries to combat the spread and increase of cancer. Dr. Woglom of Columbia University, New York City, and Dr. Bloodgood of Johns Hopkins are quoted as witnesses to the value of the work already done in certain sections of our country.

The French organization, *La Ligue Franco-Anglo-Americaine Contre le Cancer*, has a program which includes research, maintenance of cancer hospitals and dispensaries, and popular educational propaganda.

The Spanish Red Cross and the South African Red Cross have both undertaken special propaganda.

In Switzerland the *Association Suisse Pour la Lutte le Cancer* is carrying on active propaganda and is collecting statistics for research.

Aside from voluntary associations many public health departments have undertaken the work of cancer propaganda. The U. S. Public Health Service, the Department of Public Health of Western Australia, and of New Zealand, and several health departments in Great Britain have issued pamphlets in the effort to spread the knowledge of cancer prevention and treatment. The recently formed Cancer Committee of the French Ministry of Health includes educational propaganda on its program and the Committee on Cancer of the British Ministry of Health contemplates similar propaganda.

The editorial voiced the hope that the question of educational campaigns against this disease would be brought up at the Inter-Allied Congress on Cancer, which was to hold a meeting in July at Strasburg. The editor believes that evidence presented by countries carrying on this propaganda would do much to intensify future efforts.

The Immediate Effect of Radium and X-Rays on Enzyme Action. S. Clement Roth and John J. Morton, M. D. Am. J. Roentgenol. 10: 407-408, May, 1923.

THE authors say in the conclusion of this report: "From a consideration of the results which follow the radiation of pepsin solutions by x-rays and the gamma rays of radium, there does not appear to be any definite effect on the enzyme activity which was determined by the edestein, globulin and Mett methods. Such slight variations as were noticed fall within the limits of experimental error."

The Problem of Radium and Surgery in the Treatment of Cancer. A. Strauss, M. D., Ohio State M. J., 19:85, Feb., 1923.

DR. STRAUSS advocates the following methods: Because of the high operative mortality, the mutilating operation to which few will submit and the low percentage of cures, cancer of the tongue is to be treated with radium to the local lesion and radium plus surgery to the glands of the neck. This also applies to recurrences and carcinoma of the lower lip. Carcinoma of the breast is still considered a surgical disease with radium and x-rays as efficient aids. In fundus cancer, heavy intrauterine doses of radium should be applied before hysterectomy. Radium is generally extending its usefulness in both operable and borderline cases of cervical carcinoma. After raying, no case of cancer of the cervix should be operated, because the recurrence will be in the parametrium. Radium is ef-

fecting nearly the same percentage of cures as surgery in cancer of the rectum, but a preliminary colostomy is required to prevent pain.

—W. WARNER WATKINS, M. D.

Preliminary Report of Results and Conclusion from One Year's Experience in High Voltage Roentgen Therapy. Roscoe L. Smith, M. D., Nebraska M. J. 8:41, Feb., 1923.

DRING the past year the author has treated over 200 cases of malignancy, most of them with extensive involvement. The original tumors have disappeared in practically every instance and the patients showed marked improvement. In about half the cases, the improvement was only temporary. Fully one half of the cases have remained well to date.

—W. WARNER WATKINS, M. D.

Advances in Roentgen Therapy with Special Reference to High Voltage Homogeneous Rays. Wm. H. Dieffenbach, M. D., New York M. J. & M. Rec., 117:354, March 21, 1923.

THE elements of the new roentgen ray therapy with the production of homogenous rays of deep penetration as we employ them are as follows:

1. Voltage controlled by sphere gap. Maximum crest at 300,000 volts.

2. Milliamperage controlled by a double meter and carefully watched by an attendant. Milliamperage kept at 4 ma.

3. Spark gap at a maximum of 20 inches, employing 16 to 18 inches.

4. Distance target to tissues, 20 to 28 inches.

5. One-sixth mm. of silver with secondary wood filter has been used for the past five years.

6. Unless contraindications are present, the primary inhibitive dose is forty minutes over one area. Two or three areas are used at one seance in certain deep seated lesions or when cross-firing is employed.

7. Ionization measurements have not been employed, as yet.

8. Repetition of dose requires experienced judgment. Do not repeat under two weeks as a rule, and preferably three weeks.

9. Area to be rayed should be larger than the visible lesion, the larger the better. Viscera not to be rayed should be protected. Adjacent and distant lymphatics should be rayed after the original focus has been treated.

10. Secondary rays are produced in the tissues following roentgen ray treatments and these may cause constitutional effects.

—W. WARNER WATKINS, M. D.

The Relation of Radiology to Cancer Control. Chairman's Address, Section on Radiology Southern Medical Association, 16th Annual Meeting, Chattanooga, Nov. 13-16, 1922. Thos. A. Groover, M. D., Southern M. J., 16:11, Jan. 1923.

IN the science of medicine, there is no "authority", and this is peculiarly applicable to the problems of cancer, and the knowledge of this should temper our enthusiastic reception of the literature distributed relating to the control of cancer. In much of this literature, radiology is referred to mainly for the purpose of warning against it, and under the guise of a public health crusade leaders in medical thought have given expression to similar sentiments. The facts in the case do not justify such pronouncements, for whatever the future of radiology may be, the radiologist is seeing more cancer at the present time than anyone else, and his is an unparalleled opportunity for gaining a comprehensive knowledge of the disease in its various aspects.

Cancer should not be handled by rote, regardless of the method employed. If we as radiologists are content to bathe a mysterious growth with a more mysterious ray, without attempting to analyze the reasons for success in one instance and failure in another, we are not living up to our opportunities nor fulfilling our duty. It is obviously futile to advise the layman to seek medical advice early, unless there is some reasonable assurance that the advice he receives will be sound; that this is frequently not the case, all who come in contact with many cancer cases will attest. We are all familiar with the stock advice and treatment given many patients showing early lesions, such as "Forget it"; We'll watch it for a while"; "A little salve"; "Paint it with iodine"; "Touch it with caustic"; "Snip it off"; "A little x-ray or radium".

"Watch it grow!" may be a fine slogan for many enterprises, but it is a pernicious one for any lesion that resembles cancer.

In mapping out a plan of attack on cancer, or a potential cancer, we must always keep clear the issue involved, namely, that if we fail to destroy the cancer utterly and completely, the cancer inevitably will destroy the patient. The radiologist has been unduly handicapped by the idea that under no circumstances must he destroy healthy cells. The radiologist must be granted some of the ruthlessness which is granted the surgeon. This may eventuate in establishing a mortality rate chargeable to the treatment, but there is no reason why the radiologist should not be entitled to the same privileges and immunities in this regard that his surgical confreres enjoy.

We are coming to realize that it is extremely hazardous to speak of curing cancer, and it may be that the evaluation of a method of treatment could better be expressed in terms of longevity and well being instead of percentages of so-called cures. We may frankly admit that while we have many "cures" we have not as yet, in a true sense, a cure for this dread disease.

—W. WARNER WATKINS, M. D.

The Electrodeless Discharge in Iodine and in Hydrogen. John K. Robertson. Tr. Royal Society, Canada, 16:151-155, Sect. III, 1922.

THIS paper describes and gives the results of an experimental study of the discharge resultant upon changing the excitant in pure dry hydrogen contained in an observation bulb. The bulb was suspended inside a coil of six coplanar turns of stout copper wire through which was passed the high frequency discharge from two Leyden jars charged by means of a small interrupterless x-ray transformer, the intensity of excitation being varied by changing the spark gap.

A previous study upon iodine at temperatures from —5° C. to 5° C. had shown a ring discharge of pale yellow when a sphere gap of the order of 1 mm. was used. The spectroscope showed this to be a continuous band from red to green followed by an absorption band which was followed by a continuous band of blue-violet. With increased spark-gap there was an abrupt change to pale green whose inner border was pink, this the spectroscope showed to have numerous bright lines with a faint continuous background in the red region. The pink border probably corresponds "to the lesser degree of dissociation one might expect in the weaker electric field nearer the center of the bulb—the lines in the pink were much feebler than in the green—what one would expect from a smaller degree of dissociation."

In hydrogen four distinctly different colored charges were observed: "(1) *whitish* in which the Balmer lines are almost absent; (2) *pink* in which both line and secondary spectra are strongly developed; (3) *red* in which "eta alpha" and "eta beta" are relatively strong and at least a portion of the secondary is absent; (4) *blue* in which, according to Masson, the secondary is entirely absent, and, moreover, "alpha beta" is stronger than "eta beta." Concerning this last point the author intends to make further study.

The interpretation of these results is not easy. It is generally assumed that

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the Balmer lines have their origin in the atom, the secondary spectrum in the molecule. But the secondary spectrum is very complex. The writer's results indicate that in a region where the Balmer lines are relatively strong (a condition which is only obtained with strong excitation), a portion of the many lined spectrum, as well as the continuous background, is feeble or absent altogether, while another group of these between "lambda" 4316 and "lambda" 4136) is strongly developed. If now we make the assumption * * * that the atom is the origin of the Balmer lines, this suggests that at least some of the lines of the secondary also may be associated with the atom. On the other hand it is well to remember that in strongly excited gas we may have not only neutral atoms and molecules, but ionized molecules. Moreover, * * * the work of dissociation plus the ionization of an atom is less than the work required to ionize a molecule. Accordingly, ionized molecules do not appear until the excitation is tolerably strong and it may be that in them is found the origin of a portion of the secondary. But the problem is far from solution and one can only make suggestions and continue observations.

"In regard to another point it has been difficult to give any explanation. It has been stated above that the red discharge (showing the Balmer lines relatively strongly developed) formed the inner portion of the discharge ring, the outer being pink. Now the expression from which one may calculate the value of the electric intensity at any point within a coil of co-planar turns shows that the field is weaker nearer the center of the coil. * * * * Why is it, then, that the red discharge, which is evidence of an excess of atomic hydrogen, is on the inner portion of the ring? The question is all the more puzzling because in iodine, as noted above, the reverse was the case. The inner portion of the ring showed the lines less strongly developed, as one would expect to be the case in the weaker field. The writer has no explanation to offer."

The author contemplates further work upon this problem.

The Electrodeless Discharge in Certain Vapors. John K. Robertson. Physical Review, N. S. 19:470-477, May, 1922.

ELECTRODELESS discharge as a source of sharp lines should be of value in measuring wave lengths and in analyzing, with an instrument of high dispersion, lines with components due to isotopes.

This paper gives the results of the author's study upon iodine (see preceding abstract), potassium, sodium, lithium and mercury.

In potassium at a temperature of from 250° to 300° C. the ring discharge is not so sharply defined as in iodine. It consists of a pale green portion with an outer border of orange yellow, and a violet region may be seen if sufficient electrical intensity is used. With the small dispersion of the spectroscope available, exact measurements of wave length were not possible. The author from his observations, however, believes that "one might expect for potassium lines a separation of possible components approximately (0.002 to 0.005) x 207/40 or (0.01 Angstrom units to 0.025 Angstrom units)."

Sodium at a temperature above 300° C. gave a brilliant yellow discharge. "In addition to the D lines, the first four doublets of the diffuse series were identified as well as the first three of the sharp series. The Balmer lines of hydrogen, the most likely impurity, were not visible."

The lithium used was of unknown purity. "By using an iron capsule in the side tube a small quantity of the metal was vaporized and deposited in the bulb, but although the oven was heated as high as 500° C. nothing but a feeble discharge due to impurities was obtained."

With mercury a brilliant white discharge was obtained at 70° to 110° C. or higher, "the exact temperature at which it disappeared increasing with increasing spark gap. On the other hand observations made with spark gap 1 mm., 2 mm., 4 mm. and 6 mm. in length indicated that the temperature at which the glow begins (110° to 115°) is independent of the electrical intensity. The origin, therefore, of the continuous spectrum is probably closely connected with the density of the vapor. Very recently R. W. Wood has made the statement that mercury vapor can be made to fluoresce only when freshly liberated from the fluid metal, and suggests that the formation of diatomic molecules is necessary for the phenomenon of fluorescence. That such a grouping of atoms is possible is evident from the work of Sir J. J. Thompson on positive rays, in the course of which he showed that even at the low pressures obtaining in his discharge tubes, it was possible to have clusters of four mercury atoms with a single positive charge. As such groupings would occur much more readily at vapor densities cerresponding to temperatures over 100° C. it would seem that the 'radiators' of the continuous spectrum are to be found in such clusters, an idea which has been previously suggested by more than one writer.

"With the temperature of the vapor approximately constant (at say 90° C.), observations were made at various spark lengths. It was found that below a minimum gap length (of the order of 0.5 mm.) the bright white discharge gave way to a faint white luminosity whose intensity was greater in the plane of the coil, while above this length, the ring discharge disappeared."

Dosage Tables for Roentgenology. By Dr. G. Holzknecht, Professor of Radiology at the University and Chief of the Central-Roentgen Institute of the General Hospital, Wien, Germany. Price sh. 2:6. Published by Franz Deuticke. Address: Frank Deuticke Verlag, I, Helferstorferstr. 4, Wien, Germany.

THESE tables, printed in very readable type on a single sheet of paper 24 by 12 inches, are cleverly and concisely arranged to give the dosage and technique for every type of x-ray treatment which the author has found worth while in his practice. The scheme is the result of the author's effort to present the technique in a simple, compact, workable form for others to follow. A pamphlet (12 mo) of 33 pages accompanies the tables and contains an index to the technique as well as much additional information concerning the treatment of specific lesions.

The author states that the technique herein described may be safely and successfully used by anyone who knows how to properly handle x-ray apparatus, but he emphatically states that this knowledge and skill is requisite and that nothing but study and training will supply it.

There are two indexes given. One is a general index alphabetically arranged, while the other groups the names of the lesions according to the nature, location found, etc. Opposite the name of each lesion appears a Roman numeral which refers one to the table. For instance both acne vulgaris and carbuncle have the Roman numeral VI printed after them, and by referring to this number in the table one finds the general technique tabulated. Exceptions and deviations from the general technique are given in the table and any further necessary information is supplied in the pamphlet and is found by reference to the page number given in the table.

The technique is the latest tried out by Dr. Holzknecht and he states that it is not intended to be so hard and fast that no variation from it is possible. It is meant to be flexible enough to be varied as the individual case may require.

This publication should be very useful to radiologists having a fair knowledge of the German language.

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Twentieth Century Advances in Cancer Research*

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Introduction

I have thought that a survey of cancer research at this time, albeit incomplete and more or less popular, might be of interest, because the subject is highly technical and requires for its mastery more time than the ordinary physician or educated layman has at his disposal; because it takes a considerable time for the newer researches to become a part of current knowledge, and finally, because only a specialist can decide what is important and what is trivial, mere speculation, or theory without an adequate experimental basis, and he not always.

The most striking difference between the researches of the last twenty years and earlier researches on cancer is that while formerly the chief dependence was placed on *observation*, latterly the open sesame of exact *experiment* has been added, and that too on a large scale, in many localities. Paraphrasing Borrel, we may now say: twenty years of experimentation have taught us more about cancer than the previous twenty centuries of sterile observation.

In what follows I shall touch only on the conspicuous features of a few of the outstanding experimental researches of the last twenty years, and it must be understood that many of these experiments were suggested by earlier observations and cruder experiments, which for lack of time and space I shall not mention, but which nevertheless would have their place in any full historical survey. Such a full survey has been attempted by Jacob Wolff and covers more than 2100 closely printed octavo pages (Gustav Fischer, Jena, 1907, 1911) and would require at least another 500 pages to bring the subject up to date.

In 1896 the German cancer pathologist, Dr. Hugo Ribbert, a strong personality, energetic, persuasive in speech and facile with pen and pencil, propounded a doctrine of cancer causation which within the next ten years overturned pretty much everything that had been received during the previous half century as certain or probable in cancer research, beliefs founded on the labors of many men, and conspicuously in Germany on those of Thiersch, Waldeyer and Virchow, three very great names in human anatomy and pathology. These men held an open mind as regards parasitism in cancer but Ribbert's mind was closed and sealed to all such explanations.

By 1905, partly through Ribbert's writings, partly as a result of the failure of many attempts at isolations, the idea of parasitism was so entirely set aside that no European cancer worker of any great importance believed in it any more, not even Ribbert's opponents.

Cohnheim's theory of embryonic "rests," which for a time displaced Virchow's irritation theory, having now been abandoned as contrary to a multitude of clinical observations, Ribbert advanced the idea that cancers are due to the multiplication of one or more epithelial cells displaced from their fellows by trauma or by excessive connective tissue proliferation, which he conceived to be always the necessary first stage in the cancerous process. Hauser, Hansemann and other opponents, while agreeing that no parasite is involved, strenuously maintained that the first tissue to proliferate is always the epithelium and that connective tissue proliferations are always secondary, nonessential and sometimes altogether wanting; and that view continues to be the general opinion today. Ribbert first maintained that all the morbid proliferations of a cancer are the product of a single cell or cell-group but later he was forced to qualify this view and to accept the doctrine of multicentric origins for such cancers as were described by Krompecher and by Petersen, but always he strenuously denied that there could be any conversion of adjacent normal cells into cancer cells, although it is not a far cry from multicentric origins to growth by apposition, as Lubarsch has pointed out.

Ribbert's explanations were largely theoretical, based on assumptions, and may be said to have raised more questions than they settled, and more and more in recent years his theory even when modified so as to be scarcely recognizable is seen to be inadequate. The modern drift is entirely away from Ribbert's ideas.

At the present time a considerable number of cancer workers have come to believe that, after all, cancers may be due to parasites or viruses, while the greater number perhaps, occupy a middle ground, neither believing nor disbelieving but awaiting evidence, and only a minority still strenuously maintain the non-parasitic view. Most workers are convinced, however, that if not always, at least nearly always, cancers begin in continually irritated places. The amount of clinical evidence in favor of such a belief is enormous, the experimental evidence obtained on the lower animals is incontrovertible and accumulating all the time and the practical leadings of such a view are obvious. We will now take up some of the observations and experimental researches which have led to this change of opinion, and which seem to point to parasites as probable causes.

I. Transplantation Experiments

We may first consider a few of the results obtained from transplantation experiments.

Beginning with Jensen's brilliant work on mouse cancer, in 1901-03, workers in many laboratories took up and diligently followed this lead, using at first his mouse cancer and subsequently many other forms of cancer found in mice and rats and other experimental animals, and to such an extent that some cancer laboratories have had as many as 20,000 mice under observation at one time and often as many as several thousand. Jensen was not the first to successfully transplant

*(With special reference to etiology.) Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 7, 1922.

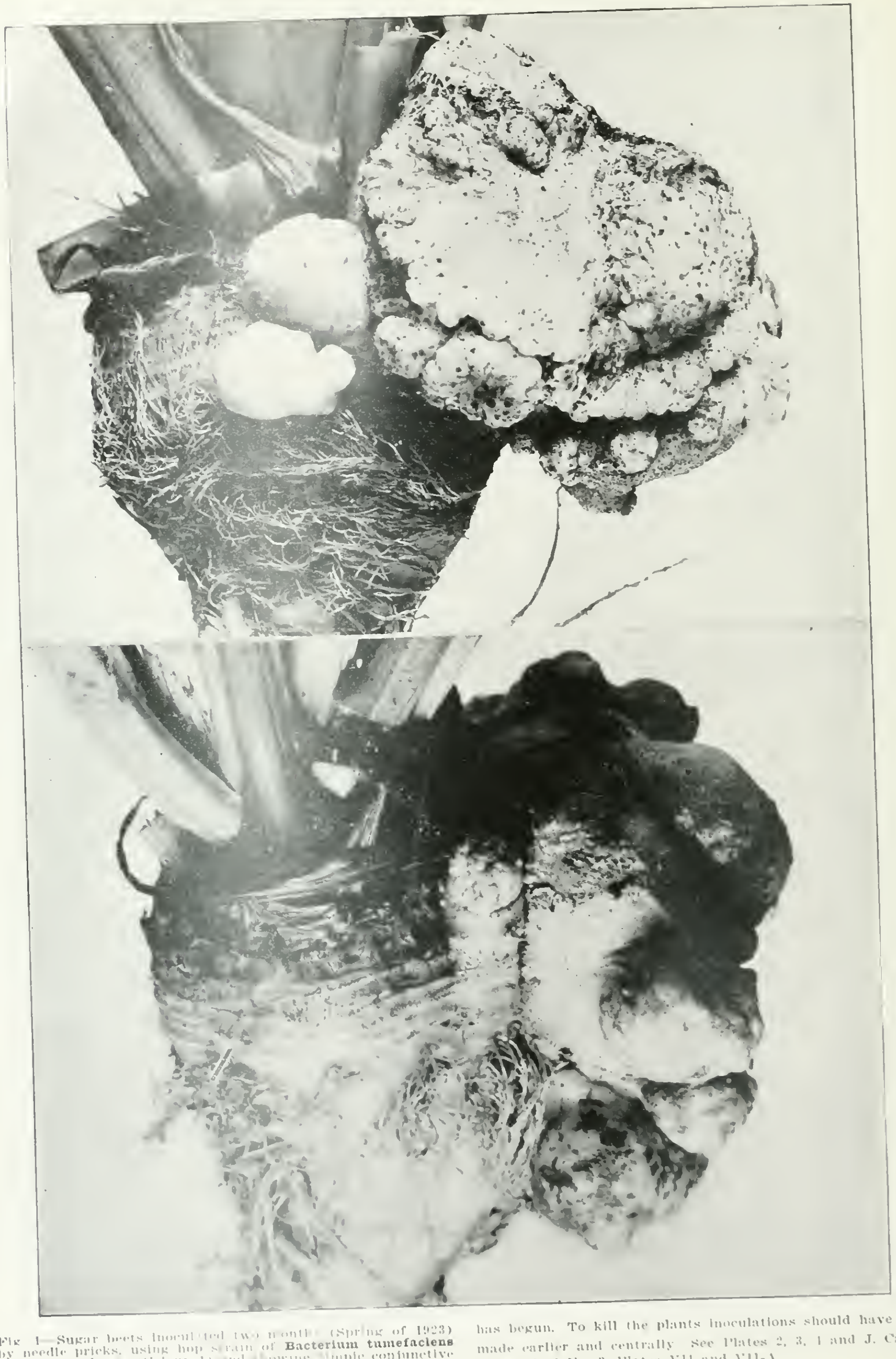

Fig. 1—Sugar beets inoculated two months (Spring of 1923) by needle pricks, using hop strain of **Bacterium tumefaciens** through sunflower (Colony 1) and showing simple conjunctive tissue tumors. About natural size. Necrosis (dark specking) has begun. To kill the plants inoculations should have been made earlier and centrally. See Plates 2, 3, 4 and J. Cancer Research, 1 No. 2, Plates VII and VII-A.

cancer. Leo Loeb's work on rat thyroid sarcoma was earlier and there were others before him, but Jensen's work arrived at the psychological moment, which always means a great deal, and he was able and willing to give his tumor to all who asked for it.

These transplantation or grafting experiments have taught us many things as to the behavior of cancer under a great variety of controlled conditions, and may teach us much more, especially as to therapy, but nothing definite has been learned from them as to etiology unless it be this that a cancer may begin as a carcinoma and end as a sarcoma. The transplants are to be regarded as artificially produced secondary tumors and a study of their behavior tells us nothing about how the parent cells became abnormal.

One striking result has been the discovery that, in general, animal cancer is transplantable only within very narrow limits, viz., within the species in which it has originated, and often within still narrower limits such as particular races of a species or individuals of a race. Growth nearly always follows when a fragment of a spontaneous tumor is re-introduced into the same animal in which the tumor has arisen, whereas the result is positive only in a very small percentage of other spontaneously attacked and normal mice (Haaland, 1911). This proves nothing, however, as to what cultures of a cancer organism might do in susceptible races when introduced in quantity so as to obtain "mass-action," and quite recently we have come to believe that this feature of transplantation has been overstressed and that under certain conditions cancers are more widely inoculable by transplantation than was formerly supposed. Rous showed that his chicken sarcoma No. 1, transplantable and inoculable at first only within one family of a race, could later be produced in other families of this race and finally in other races of the species. Sticker claimed that when he transplanted a dog cancer into a fox the tumor continued but only fox-cells grew. Dagonet maintained that he transplanted lymph-gland metastases of a recurrent human penis carcinoma into the abdomen of a rat with positive results in the spleen and liver where a structurally identical keratinizing carcinoma developed. Here, of course, it was not the human cells that grew. Carl Lewin states that he obtained positive results in the abdomen of a dog by transplanting a rapidly growing very malignant human ovarial carcinoma, but the resulting tumor in the dog was a round cell sarcoma which he subsequently carried through five transplant generations. Several other workers have claimed similar positive results but all of these have been on too small a scale to preclude accident or else the resultant tumors have been interpreted by other cancer workers as granulomata.

Keysser, the last, who has had much experience with Wassermann, and who is privatdocent for surgery in Jena, says that all his earlier efforts to transplant tumors from one animal species to another were negative, corresponding to those of Uhlenhuth, Weidanz and Sticker. He finally succeeded, however, he says, by what he calls *increasing the sensitiveness* and *decreasing the specificity* of the tumor to be used as a transplant. For his first experiment he selected a very virulent, recurrent testicle sarcoma, the large metastases of which on the breast and abdomen had at first receded under x-ray but had returned four weeks later and were then resistant to and irritated by x-ray. The virulence of this tumor was further heightened by giving the man an autolysat injection of a shoulder sarcoma from another man. Following this injection the growth of the subcutaneous metastases increased rapidly and after five weeks the metastases were extirpated and a fine water-emulsion prepared which was injected into various organs of mice. One mouse died at the end of 9 months with a cherry-stone size, solid, white sarcomatous tumor in the liver, pinhead nodules in the spleen, and 3 c. c. of blood in the abdominal cavity. This liver sarcoma has been transplanted through four generations (Arch. f. klin. Chir., 22 Okt. 1920, S. 730-736) with increasing virulence but the growth progressed much more slowly than in transplants of tumors from mouse to mouse. Here it would seem, since human cells are not likely to have grown in a mouse, that, if what happened stands in any relation to what was done, a cancer virus was transmitted, and, in the light of Rous's work on chicken sarcoma, this is not improbable. But one swallow does not make a summer.

Transplantation experiments have shown also that the host provides the stroma, that generally, at least, it is only the inserted tumor cells which grow and but a small part of these yet possibly there are exceptions (Borrel, Sticker, Lewin, et al); and that resistance to cancer is an extremely variable matter within the individuals of a given race and even within the same individual at different times.

Another striking thing, now well demonstrated by many observers is that a transplanted carcinoma may grow for a series of generations in its original form and then become a mixed carcinosarcoma and finally a pure sarcoma (vide Leo Loeb, 1903, and Bashford, Imp. Cancer Res. Fund, 4th Sci. Rep., 1911). This change from an epithelial to a connective tissue tumor has been explained in various ways, all hypothetical, as for example: (1) the carcinoma in some way chemically stimulates the connective tissue, either its own or that of the host, it is not certain which, into a sarcomatous growth; (2) the carcinoma has transmitted some cancer germ or virus to the neighboring connective tissue cells; (3) the spindle shaped cells are changed epithelial cells, *i. e.*, the tumor is really a carcinoma masquerading as a sarcoma (Krompecher's view).

It was believed for a long time that mouse cancer transplants never produced metastases, and ordinarily they do not when placed under the skin, but they may do so as a result of traumatism or if placed in deeper parts of the body.

Multicentric origins are frequent in mammary tumors of the mouse (Haaland).

II. Resemblances of Crown Gall to Cancer

In 1907, and many times since, the writer and his colleagues in the United States Department of Agriculture (Brown, Townsend and McCulloch) showed that a widely distributed plant tumor, known as crown gall, is due to a schizomycete (*Bacterium tumefaciens* Smith and Townsend), and with virulent strains of this organism can be produced at will (100 times out of 100) on sensitive plants by pure-culture inoculations.

Also beginning in 1909 the writer pointed out repeatedly, and is still doing so, many ways in which this tumor seemed to him to resemble malignant animal tumors. The following are some of these ways:

Existence of primary tumors giving rise to tumor strands on which are secondary tumors having the structure of the mother tumor, which tumor may be a plain connective tissue hyperplasia or a solid embryoma; tumors non-capsulate growing chiefly from the periphery and composed of innumerable, disoriented, rapidly-multiplying, easily-perishable, deep-staining, invasive or crushing, single-nucleate or multinucleate tumor-cells, supported by a variable amount of stroma consisting of cortex cells or their equivalent (ray cells and pith cells) and of distorted vessels developed out of the round-about normal tissues; growth by apposition occurs and the nuclei, which usually divide by mitosis, are often notched and cleft or even completely divided without mitosis. How long the tumor remains alive depends apparently on the amount of its stroma.

As the tumor grows, neighboring tissues are crushed and exfoliated, distal tissues are starved while proximal tissues especially those under or in the

Fig. 2—Crown-gall inoculations on **Bryophyllum calycinum,** showing dwarfing and killing effect of inoculating young plants in the terminal bud region. Of the ten plants in the foreground all are dead except the two at the left (time, nine months). Controls in the background. These plants were exhibited May 1, 1922, at the Washington meeting of the American Association for Cancer Research, at which time all were alive and the controls much smaller. They were inoculated by needle pricks with **Bacterium tumefaciens** plated from a tumor on the peach. Behind the screen are the controls of the plants shown in Figure 3. Photo, Sept. 8, 1922.

vicinity of the tumor are often swollen by excessive multiplication of normal cells, *i. e.*, a collateral hyperplasia is developed. The tumors may be cut out or destroyed by caustics but are liable to return; they decay first centrally. The growth is injurious to the whole plant if it is centrally located, *i. e.*, not on some remote root or branch. Apparently some species are immune (olive, onion, garlic), others are slightly susceptible (avocado, most monocotyledons) and still others highly susceptible (raspberry, blackberry, rose, peach, almond, grape). There appears to be also a variable individual resistance within the species or variety. In susceptible species the amount of injury depends greatly on the age of the plant and on the location of the tumor. One successful crown-gall inoculation does not protect the plant from a second infection. Young plants are most susceptible and may be killed by a terminal bud inoculation and when not killed are badly dwarfed.[1] The organism probably gets in only through wounds and probably lives in the soil. In one instance I observed development of the tumor two years after the inoculation. These facts are so well known that I need not here do more than recapitulate. I will only stop further to say that they came from such a strange source that they did not make much impression on cancer workers, at least not at first. When I began to write on crown gall and talk to cancer specialists about it they laughed at me. That any cancer could be caused by a parasite was then believed to be impossible. The cell itself was regarded as the only and all-sufficient parasite. Now we know of half a dozen cancers due to parasites, and there will be more when all the experimental evidence is in.

One of my manuscripts was rejected by a German journal as "zu Botanisch"; a second German critic said, "The disease has nothing in common with cancer but its name," while a third likened the tumor to smut balls in maize, which it does not in the least resemble, and said all this had been known in Germany for a long time; but I have lived to see several long papers on crown gall published by German workers in their cancer journal (Zeitschrift f. Krebsforschung) and also the establishment of a special section for the study of plant tumors in the German Imperial Institute for Cancer Research in Berlin. I recall also, very well, certain kindly but sceptical comments which followed the reading of my first paper before the American Association for Cancer Research in 1909. One colloquy was about as follows: "Well, Doctor, you have a very interesting disease but it has nothing to do with cancer." "Why not?" "But you produce it with a *parasite*, do you not?" "Yes." "Well, there is no parasite in cancer!" Here was Ribbert's dictum over again, the whole argument based on an assumption and revolving in a circle, just as in the past we have heard the same argument applied to leprosy and tuberculosis. Gradually, however, I succeeded in interesting a great many physicians and surgeons, at home and abroad, and won over various persons. In America Cullen, Adami, Bloodgood, Weil, Abbe, McCarty, Gaylord, Loeb, Hazen, and other cancer men expressed great interest in my work. In Paris, Borrel of the Pasteur Institute accepted it, and in Copenhagen, Jensen.

Borrel (1912) wrote as follows (1er Cong. Int. Path. Comp. T. I):

"Pour nous, le cancer est une maladie infectieuse et le caractère particulier de cette infection est précisément de créer dans l'organisme par une véritable symbiose une cellule nouvelle, une cellule lichen, un organisme nouveau, le cancer qui est bien au sens des anciens le *crabe rongeur attaché à sa proie*, l'être monstrueux nouveau capable de se multiplier indéfiniment sur de nouvelles victimes: la cellule cancéreuse doit être considérée comme le produit incestueux d'un parasite et de son hôte.

"Cette symbiose nous la retrouvons surtout dans le règne végétal, (la pathologie n'est pas forcée de s'arrêter au règne animal), elle caractérise les lichens, elle caractérise les nodosités des légumineuses où nous voyons le protoplasma cellulaire comme remplacé par des milliards d'êtres microscopiques qui sont les bactéroides; nous la retrouvons dans les tubercules des orchidées et des bégonias où la presence d'un parasite rend vivaces des cellules qui sans cela seraient éphémères. On les a retrouvés, ces parasites, sous forme de mycorrhizes dans les racines de presque tous les végétaux vivaces. * * * * * nous la retrouvons, le fait vient à peine d'être établi, dans les tumeurs cancéreuses végétales si bien étudiées par Smith et qui ont des métastases comme de vrais cancers humains. Le fait est capital, ces tumeurs sont greffables comme les cancers animaux et greffables en tant que cancer, comme Jensen l'avait établi avant que Smith ne découvre le microbe et voilà le premier cas d'un cancer véritable répondant à la définition du cancer et causé par l'inoculation directe d'un microbe; une tumeur de la betterave inoculable à la betterave par greffe et inoculable à la betterave et à beaucoup d'autres végétaux par des cultures.

"Nous n'avons pas encore un cancer animal de démonstration pareille, bien que certains observateurs considèrent le cancer de Sticker comme greffable et inoculable. Nous ne savons pas inoculer le cancer chez les animaux et pour cela le virus reste à l'état d'hypothèse, mais je dirai à l'état d'hypothèse probable. Les expériences de Rous, faites à l'Institut Rockefeller, si la tumeur étudiée chez la poule est bien un sarcome greffable, seraient le premier exemple d'une tumeur cancéreuse inoculable directement et inoculable par un virus filtrant."

In Copenhagen in 1918 Jensen, the well-known student of animal cancer, the discoverer of Jensen's mouse cancer, and the Director of the Serum Laboratory of the Danish Veterinary and Agricultural School, published in Danish a paper on crown gall embodying his own experiments of the preceding ten years, but also discussing the work done elsewhere, and especially that done in the United States Department of Agriculture. After stating that on critical examination of most comparisons between plant and animal tumors the analogy entirely fails, he continues as follows:

"An exception in this respect is found in a tumor-form met with in many species of plants and known in America under the name of 'crown gall'; though several years has this disease been the object of thorough investigations by Erwin F. Smith and his co-workers, in the last years through these investigations interest has been aroused in wider circles for this plant tumor that has by Erwin F. Smith (and beyond a doubt correctly) been placed as analogous to the malignant neoplasms in animals. (Serum Laboratory No. LIV, p.96).

"The beet-tumors are undoubtedly caused by the already named *Bacterium tumefaciens* but when I commenced my investigations this fact was still unknown, and everything seemed to indicate that this new formation had no origin of this kind. In spite of the bacterial origin of the disease, this new formation in beets (and in several other plants) is of the greatest interest from a comparative oncological point of view. (p. 97).

"As also mentioned, I thought, when I commenced my researches, that I might consider it certain that parasites formerly brought into etiological connection with the tumor-formation could not be made responsible for this; and rather far-reaching investigations, especially bacteriological, which I, myself, undertook did not show any microbes that might be considered the cause of the disease. Hence, I considered it rather certain that the tumors of the beets were not of a parasitic origin. In the meantime in 1911[2] a thesis was published by Erwin F. Smith and his co-workers, Nellie A. Brown and C. O. Townsend that made it necessary to take up anew the search for microbes in the tumors of the beets. (p. 122).

"Hence, I can fully share the opinion of Erwin F. Smith that 'crown gall' is a new formation which (irrespective of the cause of its formation) can be placed side by side with the real malignant tumor-formation in the higher animals. (p. 136).

"The author draws, and undoubtedly with full right, very far-reaching analogies between the forms examined of 'crown gall' and the malignant tumors of animals. (p. 134).

"Through all these properties this tumor shows very considerable points of similarity with the animal malignant tumors, especially with the carcinomas." (p. 135).

Recently after seeing many of my inoculated plants and stained sections the English pathologist, Dr. E. J. Butler, wrote as follows in his paper on "Some Relations between Vegetable and Human Pathology" published in the London Lancet (Jan. 21, 1922, p. 160):

"The first is tumour formation in plants as exhibited by the well-known crown-gall tumour caused by *Bacterium tumefaciens*. I have recently had an opportunity of discussing with Dr. Erwin F. Smith, of Washington, this disease, which he has been studying for the last eighteen years. His work is regarded by plant pathologists throughout the world as of great value. The tumours caused are usually hyperplasia, arising from the repeated division of the cells to produce a solid small-celled tumour tissue without cavities. The cells are

Fig. 3. Crown-gall inoculations on Bryophyllum (time, eleven months). Two dead and the others dwarfs. Controls of same age and origin, and under the same conditions as to light, water, size of pots, etc., are shown in the background. Beyond these are the tobaccoes referred to (Figure 1) as inoculated six inches below the terminal bud. These plants were exhibited May 1, 1922, in Washington at the annual meeting of the American Association for Cancer Research. They were inoculated Sept. 16, 1921, with **Bacterium tumefaciens** from hop by needle pricks in the region of the terminal bud when they were about six inches high, that is, larger than those of the preceding figure. Photo, Sept. 8, 1922.

often markedly embryonic in character and divide mitotically and amitotically. Secondary tumours frequently develop, often at a considerable distance and deep-seated in the tissues. They are not caused by migration of the bacteria across normal tissues, but by a definite outgrowth from the primary tumour in the form of a tumour-strand of infected cells of marked characters and easily recognized in section, though often only a few cells thick. Such strands have been traced for eight inches in length. The secondary tumours have the characters of the primary, so that if a leaf bears tumours secondary to one on the stem their structure will be a stem structure. Secondary tumours can also be produced by grafting a part of a primary tumour on a suitable part of the plant. Growth of the tumour is unlimited and devoid of polarity, and the destructive action on the plant is usually merely the result of pressure and crushing, though necrosis permitting secondary infection is common.

"The structure of the tumour varies according to the tissue primarily infected. Most of them are of the ordinary ground or conjunctive tissue cells—e. g., in the cortex or pith—and are the nearest approach that one could expect to get in plants to sarcomata. There is no epithelium in plants, and the epidermal tissues are thin, usually a single layer, and hard to inoculate without involving the underlying ground tissue. But a few cases have been described in which the tumour appears to be composed mainly of epidermal elements, including hairs (the plant hair being an outgrowth from a single epidermal cell), and these may be compared with epitheliomata. The most interesting type, however, is undoubtedly the embryomata. These tumours, first detected as recently as 1916, are composed of a jumbled mass of young shoots and roots of usually incomplete structure having only bits of organs, but sometimes forming more or less complete dwarf shoots. The secondary tumours developed from these have usually the same embryonic teratoma structure.

"The organism which causes crown gall is a cell parasite of a highly developed type, in which the host cell is not destroyed but is stimulated to increased activity. There are many such cases in plant parasites. To the best of its ability the parasite aims at preserving the life of the host cell for its own needs. That it over-stimulates the cells, causing death by crushing and necrosis, may be regarded more or less as an accident. *Bacterium tumefaciens* can be isolated and cultivated, so that its morphology and characters are well known. It is rare in the tissues, at least in an active state; in one case it was estimated that there were only 200 living bacteria per cubic centimetre of the tumour. But perhaps the most significant thing that I learned from Dr. Smith was that, contrary to his earlier belief, he is not now certain that he has ever recognised the organism in the tissues. What he previously saw he now thinks were only cell-inclusions or chondriomes. Thus we have a parasite capable of causing a tumour having all the characters of a malignant growth; the organism has been isolated, grown in pure culture, and new tumours produced at will with it, but it is not with certainty to be recognized in the tissues of the tumour.

"More recently Dr. Smith has been able to produce experimentally small tumours of limited growth, having the characters of incipient crown galls, by injecting in suitable parts of plants certain of the diffusible products of the metabolism of *Bacterium tumefaciens*, including ammonia, amines, organic acids, etc., and he considers that the tumour is ordinarily caused by the continual production of small quantities of these excreted products by the parasite.

Application to Cancer Research

"I am aware that the path of cancer research is strewn with the wrecks of parasitic theories, but the recent work on plant cancers, the experimental production of embryonic teratomata, the extreme difficulty of detecting the parasite in the cells (it is certainly *in*, not between the cells[3]), and the evidence that it acts by the production of repeated small quantities of an excreted stimulus, makes it easy to understand the view held by Dr. Smith and other vegetable pathologists, that cancer will ultimately be found due to some similar cause."

III. Rous's Filterable Virus Chicken Sarcomas

The first body-blow to the doctrine that the cancer cell is the only parasite came from work done in the Rockefeller Institute for Medical Research in New York by Peyton Rous and his associates (chiefly James Murphy) on chicken sarcomas. They were not able to isolate the agent and determine the cause of the tumors, but experimenting through a series of years they demonstrated indubitably that the filtrate of the crushed tumor cells will cause the disease, and a little later that the virus persists in cells killed by freezing, by heat, by drying, and by glycerin.

Rous's first paper published in 1910 was followed by many others (I have read 25) detailing the results of an enormous amount of exceedingly interesting experimental work. He was the first to demonstrate that an avian tumor is transplantable. This tumor (his sarcoma No. 1) retains its morphology with continued transplantation, increases in virulence, metastasizes and invades. The host rapidly emaciates, becomes cold, weak, somnolent and often dies within four or five weeks from the time of tumor inoculation. As the transplantations continued, the virulence rose, the number of "takes" increased and the metastases became much more frequent. The latter were found in the heart, lungs, liver, kidneys and peritoneum. Most of these metastases are by way of the blood stream, more rarely through the lymphatics. Lung and heart metastases are very common and these organs may be almost completely replaced by tumor tissue. In several cases there was direct extension of the tumor in vessels. The tumor was found in a barred Plymouth Rock fowl and at first the transplantations succeeded only in occasional Plymouth Rocks of the same immediate descent but subsequently other Plymouth Rocks were found to be susceptible and also Brown Leghorn fowls. The tumor was discovered in 1909 and by 1911, Rous was able to produce it by transplantation in 80 to 100 per cent of barred Plymouth Rock fowls and it was especially active in the young. It would not cause tumors in other animals—pigeons, ducks, rats, mice, guinea pigs. The tumor had and still has all the characteristics of a spindle-cell sarcoma. Cultures from it in various media, were sterile as regards bacteria. Now came the great surprise: the clear fluid obtained from the ground tumor by means of coarse or medium Berkefeld filters impervious to such bacteria as *B. prodigiosus*, and *B. fluorescens liquefaciens* was found to cause the sarcoma when injected. It was also produced by introduction of the tumor cells after being dried, or killed by heat, by glycerin, or by repeated freezing and thawing.

Only a small proportion of the injected fowls develop the growth when the Berkefeld filtrate is used and the tumors are few in number. They occur along the needle track and are much slower in developing than when tumor tissue is used but otherwise they are typical. On the contrary when the irritating tumor powder was introduced in Ringer's solution the tumor was found in many fowls. Powdered diatomaceous earth was then introduced along with the filtrate to increase its infective power and in such cases the tumors were more frequent and were multicentric at first but subsequently coalesced. This earth injected alone does not cause tumors but it is quite plain that the introduction of diatomaceous earth or dried tissue sets up an irritation exceedingly favorable to the production of tumors when the virus is present. This agrees very well with the generally admitted fact that human cancers often, if not always, begin in irritated places.

By 1913 the tumor had been transplanted through 32 series of fowls (a total of 217).

The tumor agent being separable from the tumor cell the old doctrine that "the tumor cell is the only parasite" falls to the ground, so far at least as relates to chicken sarcomas and presumptively to all sarcomas. What this agent may be no one knows. In 1912 Rous spoke of the "causal agent" as "ultra microscopic in some, perhaps in all, of its forms and undoubtedly a living organism" (Proc. Amer. Phil. Soc.). In 1913 Rous and Murphy speak of the agent more cautiously as "probably a living organism."

The agent or virus has the following properties: It does not attack epithelium. It is destroyed by tissue autolysis, by 50 per cent alcohol, by 2 per cent phenol, by saponin in high dilutions, and by chloroform and toluol in such quantities as are destructive to bacteria. It is destroyed by temperatures above 53° C., and will endure only a little more heat than the tumor cell. It resists long drying. It stands freezing and thawing well. It withstands 50 per cent glycerin for at least a

Fig. 4—Effect of inoculating **Bacterium tumefaciens** by needle pricks into the region of the terminal bud in young tobacco plants. The organism used was cultivated from a tumor on the peach. All developed tumors, also the main axis was killed in all. Of the fifteen inoculated plants eight were killed outright, seven pushed dwarf basal shoots and one fruited sparingly. Three of the dead ones are not shown in the photo. All died about two months later. Controls at the left. These plants were exhibited May 1, 1922, in Washington at the annual meeting of the American Association for Cancer Research, at which time all were alive. Of another set inoculated at the same time and in the same way (by needle pricks) but six inches below the terminal bud, that is, in a less critical region, all developed tumors and all were somewhat dwarfed, but all blossomed and fruited. (See left side of figure 5 A, B.) Photo, Sept. 8, 1922

month. It will not pass a porcelain (Chamberland) filter or a dialyzing membrane. It will pass through most Berkefeld V-cylinders and many Berkefeld N-cylinders, but is retained by most of the fine-textured W-cylinders. It is not destroyed by arsenic compounds. Ultra violet light destroys the tumor cells without destroying the causal agent. X-rays have little effect either on the agent or the sarcoma cells.

"These various features seem sufficient to identify it as a living organism in distinction from a ferment." (Rous, l.c., p. 204.)

"Growth of the tumor, dissemination, injury to the host, immune processes all are referable to these cells suddenly endowed with new properties." (Rous, l.c., p. 204.)

"During the last three years more than a thousand fowls, with or without the tumor, have been kept together in close quarters, yet no instance of natural transmission has been observed." (Rous, l.c., p. 205.)

"In conclusion it should be stated that the experiments with chicken sarcoma have not yielded a method whereby a causative agent can be separated from the tumors of rats and mice. But they clearly prove that the characteristics of malignant tumors in general are compatible with the presence of a living causative agent. Such a cause for them seems, indeed, far from improbable." (Rous, 1912. Proc. Am. Phil. Soc.)

Subsequently Rous and his associates demonstrated that two other chicken sarcomas—a slow-growing osteochondrosarcoma (No. VII) and a peculiar sarcomatous tumor with innumerable blood rifts (No. XVIII) are due to filterable viruses. These viruses differ in a number of ways from the virus of his sarcoma No. I—that of No. XVIII, for example, is destroyed by drying, and by glycerin, and No. VII survives drying only when frozen. Cultures from these tumors on various media were also sterile as regards bacteria.

Two replies were open to objectors, and there were many. Some said, especially in the beginning: The disease is not a genuine sarcoma but only a granuloma. Others said: Possibly some tumor cells more resistant than others have escaped the heat or cold, or have passed through crevices in the filter and have multiplied in the tissues after injection. But fair-minded investigators are now generally agreed that the disease is a sarcoma and, in answer to the second objection, Rous ground up his chicken sarcoma cells, dried them over sulphuric acid, pulverized them, kept this dry dust for seven months, and yet with it was able to produce the disease. *The cell, therefore, is not the parasite, but some other living thing may be.* Where it passes the rest of its existence is not known. As long as we do not know what this something is we may very well call it the virus, or the *agent*, as Rous has done.

This work on chicken sarcoma has been verified in Japan, including the filterable virus, by Akira Fujinami, who tells me that he discovered the tumor independently but that Rous published first.

IV. Worm Cancers

As leading up to the specific experiments I shall mention under this heading, it is well to say that, owing to the labors of many observers covering a series of years, and especially to those of Borrel, attention has been drawn repeatedly to the suspicious close association of various parasitic worms with papillomas, epitheliomas, carcinomas and sarcomas in man and animals, e. g., the Egyptian disease of the bladder known as Bilharzia which frequently ends in carcinoma, is always associated with *Schistosomum haematobium* (*Distoma haematobium*), a trematode or fluke, passing the other part of its life in water snails of the genus Bullinus. Intestinal cancer in certain districts of Japan, more common than elsewhere, is associated with another fluke (*S. japonicum*), the larval form of which lives in another snail. Cancer of the intestine in the horse is associated (Borrel) with the nematode *Sclerostoma;* breast cancer of the mouse is frequently associated with a nematode (Borrel, Haaland) and probably much oftener than has been recorded; several times cancer in man has been found associated with *Trichina spiralis* (see pp. 33-35, Fibiger IV, Biolog. Medd. I, 10); liver sarcoma of the rat is associated with the larval form of a *Taenia* of the cat; and so on. We have also destructive nematode tumors in plants. One is due to *Heterodera radicicola.* It occurs on the roots of a great variety of plants and is more injurious than crown-gall. Structurally, the tumor is a soft, perishable, small-celled connective-tissue hyperplasia containing a great many large multinucleate giant cells. Many plants are killed by this tumor, and many others are dwarfed so badly as to be worthless. It occurs on a multitude of hosts in many parts of the world and has not received the attention it deserves. Other destructive above-ground plant tumors are due to nematodes of the genus *Tylenchus.* These occur on wheat, clover and other plants. Non-verminous forms have also been incriminated, e. g., cancer of the face (12 cases) and of the breast (6 cases) associated with the mite Demodex (Borrel, Asso. fr. p. L' Etude du Cancer, 1908-1909.) The last instance of association I recall is the recent discovery that Hodgkins' disease, which frequently ends in lympho-sarcoma, is associated with cells of the protozoan *Endameba dysenteriae.* (Kofoid, Boyers and Swezy. Jour. A. M. A., May 27, 1922.) You all know how frequently cancer develops on syphilitic and tuberculous lesions, but I am to deal here only with experimental evidence.

a. Fibiger's Rat Carcinoma Due to Cockroach-Nematodes

In 1913 Johannes Fibiger, Professor of Pathological Anatomy and Director of the Anatomical Pathological Institute of the University of Copenhagen, after a research covering more than two years, announced that he had produced in the stomach of rats inflammatory reactions, numerous papillomas and a few carcinomas by feeding them nematodes found in the muscles of a cockroach where they are coiled up and encysted like *Trichina spiralis* in the muscles of the pig. Since that date Fibiger has pursued his researches unweariedly with remarkable results which are now perfectly well established.

The story of his investigations, presented in a dozen lucid papers, is as fascinating as a romance.

The nematode lives chiefly in the pavement epithelium of the stomach of the rat. It here reaches sexual maturity and evacuates ripe eggs (containing embryos) which are liberated by desquamation of the epithelium and passed with the excrements. The feces of infected rats nearly always contain eggs but never free embryos. When such feces are consumed by cockroaches the embryos are liberated from the egg and wander into the striped muscles of the prothorax and the limbs of the insect, where after six weeks or more the larvae are found coiled up in spirals.

When such cockroaches are eaten by rats the larvae are freed from their capsules and wander into the squamous-cell epithelium of the cardiac part of the stomach or more rarely into the epithelium of the esophagus, tongue and mouth where in about two months the females begin to lay fertile eggs which soon find their way into the feces.

In most cases, especially if the rats are examined early, only inflammatory reactions and papillomas are found. But even as early as 1913 Fibiger had found 5 cases of cancer in rats fed on nematode-infected cockroaches and he has found many since. He says of these early observations:

"In 5 laboratory rats fed on cockroaches (in 4 cases *P. americana*, in 1 case *P. orientalis*) microscopical examination of the cardiac portion of the stomach showed processes which differed from those in the other rats. *The changes, in fact, here appeared to be true cancerous growths, the mucous membrane and submucosa having changed into a tumor tissue of quite the same type as is generally found in true squamous-celled carcinoma in man.*

"In two of these rats carcinomatous metastases were observed in a lymph gland and in a lung respectively; in a third case the urinary bladder contained papillomatous growth which was probably a metastasis too. Notwithstanding a very careful examination of serial sections

Fig. 5. **A**—Photo of tobacco plants, all of which were inoculated with **Bacterium tumefaciens** at the same time and in the same way except that those at the left were pricked in semi-mature tissues on an internode six inches below the top; and those at the right, in very soft tissues in the region of the terminal bud. Photographed at end of three months, that is, three months earlier than the condition shown on the right side of figure 4.

B—A closer view of the right side of **A**. Inoculated Feb. 20, 1922. Photographed May 19, 1922. The plants are in a much worse condition than they were on May 1, but not as bad as on September 8.

These experiments and the preceding on Bryophyllum combat Levin and Levine's assertion, J. Cancer Research, 5:256, et seq., that "the crown-gall is usually a benign tumor and only rarely does it act in a manner analogous to a malignant tumor in an animal," and show that, like sarcoma in animals, the disease is most destructive in the soft tissues of young plants, the host reaction in the plant as in the animal being a variable one.

neither nematodes nor eggs were found in any of these metastases, being thus metastases in the most strict sense of the term.

"*By these investigations carcinomatous tumours giving rise to metastases were produced experimentally for the first time, and the hypothesis put forward by Borrel and Haaland was thus verified,* as it has now been proved that nematodes play a causal part in the development of cancer in rats."

Dr. Fibiger was led to make these studies by finding in 1907 in the stomachs of three captive wild rats (*Mus decumanus*) enormous papillomas associated with a nematode and showing carcinomatous tendencies. These rats which belonged to the Anatomical Pathological Institute were probably imported from Dorpat (Russia). This discovery led to the examination of numerous Danish wild rats and of black and white rats from various laboratories, but neither papillomas nor nematodes were to be found. He was then led to consider another possibility: viz., that this nematode might have a second host and following Osman Galeb's discovery (C. R., T. 87, 1878) he sought for it in the cockroach (*Periplaneta orientalis*). The first search was made on wild rats in a locality where *P. orientalis* was very abundant, but all the examinations were negative; neither could the tumors be induced by feeding healthy rats with cockroaches from this locality. A little later Fibiger discovered, quite against expectation, what he was searching for in another species of cockroach (*P. americana*) from a sugar refinery where both rats and cockroaches were abundant. Out of 61 wild rats (*Mus decumanus*) caught in this locality 40 showed the nematode in the cardiac part of the stomach. In 18 of these there were pathological changes, and cancers were found in nine. Moreover, of 57 black and white rats fed on *Periplaneta americana* from this sugar refinery the worm was found in 54. In 37 of these 54 rats there were pathological changes, and cancers were found in 7. Previous to this, 1,144 rats of several species from other Danish localities had been examined without finding any nematodes or any tumors. The results obtained left no doubt as to the second host or as to the responsibility of the nematodes for the tumors. Fibiger then fed 18 cockroaches on the feces of infected rats and obtained nematode infections in the muscles of 17. He also fed 9 cockroaches on nematode eggs and obtained 9 infections, whereas the muscles of 101 non-fed control cockroaches were free from nematodes. Fibiger also showed that a second host is necessary. The round worm must pass from the rat to the cockroach, or a similar host, before it can again infect rats.

Up to 1918 the nematode, first called *Spiroptera neoplastica* and now following Ransom, *Gongylonema neoplasticum*, had been bred about seven years, using not only the large light brown cockroach, *Periplaneta americana*, but also the black-brown species, *P. orientalis*. The nematode may also be bred in meal worms and in German cockroaches, but less satisfactorily.

Feeding experiments have been made on wild house rats (*Mus rattus*), black and white laboratory rats, Norway rats (*Mus decumanus*), Alexandria rats (*M. alexandrinus*), and bastards of Norway rats and black and white rats; also on white and on black and white laboratory mice, wild house mice (*Mus musculus*), forest mice (*Mus sylvaticus*) and Japanese waltzing mice. The nematode is transmitted very readily to all of these rodents. It has been transmitted also to rabbits, guinea pigs, squirrels (*Scirrus vulgaris*) and hedgehogs. In all of these animals it lives in the squamous epithelium of the upper part of the alimentary canal, but so far as I have read cancer has been produced with it only in rats and mice, and most successfully in rats.

More than 900 animals have been used in these experiments and the results obtained on many of these animals remain to be worked over in detail but up to 1921 the nematode cancer had been found in the fundus of the stomach of more than 100 rats. This is the more astonishing because cancer of the stomach is a rare disease in rats, except as related to this parasite. Five of the rats also had cancer of the tongue, a very rare disease, except as caused by this worm. The nematode cancer had also been produced in the fundus of the stomach in white mice but in 3 only out of more than 200 inoculated. Metastases (mostly to the lungs) had been found in 6 out of 33 rats (1921) and in 2 of 3 mice, and this mouse tumor without the nematode had been transplanted through several generations of mice.

These statements, however, do not express the whole truth, for, if we exclude rats that die early of intercurrent diseases, *e. g.*, broncho-pneumonias, or as a result of the primary infection, and consider only those which survive the nematode feedings for six weeks or more, and are of susceptible races, the number developing cancer then exceeds 50 per cent.

If too many cockroaches are fed, the rats die soon after the feeding from inflammatory processes and hemorrhage (acute gastroenteritis). If their muscles are well infected, three to five cockroaches are considered enough for each rat.

From 1913 on, for some years, owing to a fire, Fibiger used only *Periplaneta orientalis* for his feeding experiments, but during the eighteen months immediately preceding the publication of his 1918 paper he again bred *Periplaneta americana* regularly and now uses it altogether for his infections, because it is more resistant than *P. orientalis* which is apt to die if overfed with nematode eggs from the rat feces. He now often feeds his rats the encysted worms dissected out of the muscles into normal salt solution rather than the cockroaches themselves, since this enables him to know the number of worms fed and especially to infect the tongue.

The natural host of this round-worm is *Periplaneta americana*, indigenous to South America and the West Indies, where both the cockroach and the rat have been found harboring the parasite. It is believed to have been imported into Denmark from the Danish West Indies on sugar ships. Except in this one species and in this one locality (a sugar refinery which was subsequently burned, destroying both cockroaches and rats) Fibiger has never seen it in Denmark.

In support of his belief that the worm is of American origin, Fibiger states that he has examined 1,300 Danish wild rats, nearly 500 laboratory rats from Denmark, England, Holland and Germany and enough Alexandrine rats to total 1,800 without finding the worm. He also cites confirmatory evidence from Wassink who examined more than 1,000 wild rats from Amsterdam without finding it, but among 625 rats caught in ships Wassink found 5 containing this nematode and these five came from ships in the South American service. He also found it in 16 out of 40 rats caught in Suriname (S. A.) Wassink examined also great numbers of cockroaches from Amsterdam but found the nematode only in *P. americana* and *P. orientalis* originating from a sugar refinery which formerly received West Indian sugar and there the parasite spent the other part of its life in mice, there being no rats in this refinery. The worm was not found in either cockroaches or rats taken from ships in the East Indian trade, but has been found in cockroaches caught in Parimaribo. Fibiger himself found it in wild rats and cockroaches caught and sent to him from St. Croix (V. I.)

The number of worms in cockroaches which have been fed on the feces of infected rats varies greatly; there may be none, a few, several dozen, or several hundred. As a rule Fibiger used the cockroaches 85 to 90 days after beginning the feedings with infected rat feces, but only a small part of the nematodes succeed in obtaining a lodging in the tongue, throat, gullet or stomach of the rat.

Fibiger cut many entire rat stomachs in series and often found two to five

Fig. 6. Two tumors from the terminally inoculated tobaccoes shown in figures 4 and 5, both of which are embryomas. The lower part of the upper one is full of roots and there are also roots at **X**. The upper part of the lower one is full of shoots (under **S**). Most of a second tumor at **Y** has decayed. Photo, May, 1922, X3

independent small centers of cancerous growth (squamous cell carcinoma with many epithelial pearls). These cancers, therefore, are often multicentric. "Most frequently a larger tumor focus was accompanied by several smaller foci of approximately equal size."

Fibiger states distinctly and emphatically that he considers the cancerous process as entirely distinct from the inflammatory and papillomatous one.

"A mon avis le carcinome est dû à un processus à part, n' évoluant que dans des conditions spéciales et s'associant comme complication indépendante et essentiellement différente à la simple prolifération épithéliale hyperplastique et hétérotopique, dont il ne représente nullement le point terminal.

"De même on constate des phénomènes inflammatoires et de la papillomatose dans tous les estomacs infectés par les spiroptères, mais il n'y a pas de rapport entre le degré de ces phénomènes d'un côté, et l'existence et la fréquence des carcinomes de l'autre. Les phénomènes inflammatoires et la papillomatose peuvent être très prononcés dans un estomac sans qu'il ait de carcinome, et vice versa. Il ne faut donc pas attribuer à l'inflammation une influence quelconque sur la croissance du carcinome en plein développement. Nos connaissances actuelles sont insuffisantes, pour juger la question de savoir si l'inflammation ne jouerait pas un rôle tout à fait au début, avant que la disposition et la transformation des cellules aient pris les caractères morphologiques typiques du carcinome, mais il parait probable que l'inflammation est plutôt un phénomène secondaire ou en tout cas coordonné à la cause qui détermine l'évolution du carcinome."

Fibiger's experiments indicate that there is a species, a race, and an individual predisposition to carcinoma. He suggests that there may be also a predisposition of special organs, since he has examined several hundred rat-esophaguses infected with the cockroach nematode but has never found a carcinoma although the organ is identical in structure with the cardiac part of the rat's stomach. Also in white mice the digestive tract is very resistant to the nematode cancer while the skin is extremely subject to tar-cancer, so that it is doubtful if we may speak of a *general* cancerous predisposition. His experiments lend no support to the belief that carcinoma is only a disease of old animals.

"Jusqu'à présent j'ai rencontré le carcinome aussi souvent chez les animaux jeunes que chez les animaux âgés."

In a few cases Fibiger also observed sarcoma-like proliferation of connective tissue (German paper of 1913.)

No nematodes were found in any of the metastases. In other words, the carcinoma once started is able to continue without the presence of the nematode. In case of the mouse cancer produced by the nematode, up to 1919, Fibiger had transplanted it through four generations without the presence of the worm. The question then arises: Is the nematode the cause? or does it only produce an irritation in which some unknown cancer virus may take root, if present? It is not unreasonable to suppose the latter may be the case because in by far the larger proportion of his inoculated rats inflammatory reactions which soon subsided, or simple papillomas, were all that Fibiger observed. Moreover, rats whose stomachs have contained egg-laying nematodes for a very considerable period may subsequently be found free from them and with normal stomachs. Even in rats that lived for a long time after the feedings and were known to be infected for many days, because eggs were found regularly in their feces, inflammatory reactions and papillomas were all that Fibiger found in nearly 50 per cent of his cases.

I shall have more to say about this when I come to discuss the cat-tapeworm rat-sarcoma and will only add here that in Fibiger's rats, in all cases, the carcinoma begins not contemporaneously in the whole irritated area, as we might expect it to do, but only in very limited portions of it, minute spots, in comparison with the whole nematode-parasitized area. This is true also of the tar cancers. Borrel believes that there is a distinct cancer parasite or virus of which the nematode is only sometimes the innocent carrier.

Fibiger's chief objection to this view is that there appears to be a proportional relation between the number of worms and the development of the carcinoma, the rule being: Few parasites, feeble changes, whereas a few worms should suffice, he thinks, to bring about a bacterial infection just as well as a large number.

He brings another objection, viz., that when the round-worm *Trichodes* bores into the stomach wall making numerous passages there results nothing comparable to what he has found, although, if wounds are necessary to let in a supposititious bacterial parasite, wounds made by one species of worm ought to serve as well as those made by another worm. This would certainly be a strong objection if based on a sufficient number of observations and if *Trichodes* also caused prolonged favorable inflammatory reactions, which does not seem to be the case, and, finally, and especially, if the supposed cancer virus is normal to the surface of the rat and mouse so that any kind of wound would be sufficient to introduce it, but, on the other hand, it might be only normal to and perhaps only occasionally present in *Gongylonema* and never present in *Trichodes* and never normal to the surface of the rat, or, if so, as would seem more likely, able to enter only into a weakened organism through a specially prepared surface which would entirely alter the situation and destroy the force of his argument. To Menetrier, as to Virchow, cancer is not a primitive morbid form but the end of multiple anterior and preparatory pathological states.

Microscopically visible bacteria as a cause of these tumors appear to be ruled out, because in only a very few cases was Fibiger able to find any.

Fibiger admits the possibility that the carcinoma may be a special process, subsequently grafted on the papilloma and having an etiology of its own, but against this he raises the possibility that the carcinoma begins in just those portions of the proliferations which have been exposed to the strongest action of the nematode poison which, he assumes, may be of variable virulence. Here then are the two aspects of the problem, both theoretical, and, as he says, related back to the whole problem of carcinoma development.

b. Kopsch's Frog Tumors Due to Angleworm Nematodes

In 1919 Dr. Fr. Kopsch, privatdozent and II prosector in the Anatomical Institute of the University of Berlin, published an octavo, 130 page monograph illustrated by 23 text figures and 23 colored plates containing 107 figures, describing in much detail tumors of the frog (*Rana fusca*) which he had produced in large numbers in various organs by feeding them angleworms containing the nematode *Rhabditis pellio*, which has been found also in inflammatory conditions in man.

Kopsch's interest in the frogs, at first, was purely anatomical and morphological. In the summer of 1915 he says he bred *Rana fusca* in considerable numbers to complete certain developmental studies, but a hitherto unobserved disease put an end to his studies by destroying the frogs. Although he had bred frogs for many years this was the first time he had had any trouble. On dissecting these frogs he discovered numerous whitish nodules in the esophagus, stomach, duodenum, liver, pancreas and various other organs and each of these nodules contained one or more nematodes, usually only one. He had fed these frogs for two months on angleworms from a certain locality and on dissecting angleworms from this region he found the same nematode. In the course of two to seven months nearly all of the frogs contracted the disease. The frogs longest infected showed the most striking evidences of disease.

The following year (1916) Kopsch bred more frogs and fed them exclusively for three and one-half months on angleworms containing the nematode, and again in many frogs he obtained the tumor-disease.

The sick frogs refused to eat, often became lean and listless, vomited food and slime containing nematodes, lay

Fig. 7—Crown-galls on **Ficus elastica** (common ornamental rubber tree) due to **Bacterium tumefaciens** (hop strain). The lower tumor resulted from inoculations made February 5, 1921, by needle pricks in the region of the terminal bud. They missed the growing point and the tumor contains no shoots. The smaller tumor resulted from a reinoculation made a month later by means of three needle pricks and has given rise to eight shoots, the two smaller ones are under the arrow. This is what Michael Levine said could not be done, either on **Bryophyllum** or **Ficus elastica** (Mycologia, Jan., 1921, p. 7). Photo, Feb. 1, 1922.

The buds in **F. elastica** are concealed by twisted bracts and are very difficult to hit with a needle, so that the plant is not well adapted for such experiments, but, contrary to Levine's supposition, it does not react differently from other plants and by making enough experiments it ought to be possible to reach the bud in such a way as to produce a tumor containing many shoots.

flat on the earth, finally with the head down, or motionless on the back in the water, suffered at times from tonic spasms, became rachitic (probably from the one-sided diet) and finally so weak that they had to be fed by hand and in this way were kept alive a few weeks longer. A few of the old frogs suffered from internal hemorrhage. Only one of the frogs lived as long as fourteen months. Many died or were killed too soon for any appearances suggestive of cancer.

Frogs fed on infected angleworms may contain an extremely variable number of the worm nodules, one or two or a few up to 200 or more. This is probably because young angleworms contain few or none of the nematodes. The older worms contain a variable number of the nematodes distributed in various organs.

The worms in the frog are enclosed in a capsule at first but after some months the capsule disappears and then the tumor becomes locally malignant.

Most of Kopsch's feeding experiments were done on young frogs beginning soon after the change from polywog, but he fed enough old frogs to know that they also are susceptible. Mice could not be infected. He continued his experiments in 1917, but only the results of the first two years are given in the monograph, which is based on the findings in 44 frogs, other frogs in the series being rejected because they died or were killed too early to obtain interesting results. The signs of the disease did not begin until after two or three months.

A great many serial sections were cut from various organs of many of these frogs.

In the 1916 frogs (28) there was nothing discoverable in the way of adenomas or cysts until the fourth month after infection, but heterotopic glands appeared much earlier and heterotopic epithelium was detected as early as the fourth week. These down-growths were extraordinarily numerous in some of the frogs (29 in No. 13). Adenomas were also numerous in some of the older frogs (54 in No. 16). After about 5 months the capsules are disintegrated and absorbed and the tumor cells are then free in the tissues and locally malignant, reaching out irregularly and compressing and destroying surrounding cells. The liver from frog No. 29, which was nine and one-half months old contained 26 worm nodules, of which 21 had lost their capsule and had become locally malignant.

No convincing evidence of metastasis is furnished but it is likely that further studies may furnish it.

Kopsch has not done as much work as Fibiger, nor carried his investigations as far, but what he has done is exceedingly interesting and points in the same general direction. His text is not altogether convincing as to carcinoma and sarcoma and most of his figures indicate to me only inflammatory changes, benign adenomas, heterotopic growths of epithelium, etc., but in a few cases in the frogs longest infected he figures and describes changes which must perhaps be interpreted as beginning carcinomas with epithelial pearls. In a few cases he also obtained changes which he interprets as beginning sarcomas. He should furnish more convincing evidence both of deep invasion and of metastasis, and probably will do so. His work, if it stood alone, would not be entitled to as much weight as it must receive, following, as it does, Fibiger's convincing studies.

c. The Rat Liver-Cyst Sarcoma Due To a Tapeworm of the Cat

In 1910 (An. de L'Inst. Past.) and again in 1912 in his paper before the first International Congress of Comparative Pathology, Borrel of the Pasteur Institute in Paris called special attention to this rat liver-cyst sarcoma in which he said he had been interested for nearly ten years, having found eight cases of it. His labors and the concordant labors of Regaud, Saul, McCoy, and Bridre had resulted up to that time in finding 50 cases of the disease.

The life cycle of this parasite is as follows:

Taenia crassicollis, the perfect form of the worm, lives in the intestines of the common cat. The eggs of the worm are voided in the feces of the cat, which are eaten by rats. In the stomach of the rat the eggs of the worm hatch and the young larvae bore through the walls of the stomach and intestine and lodge in the liver. A wall of fibrous protective tissue, the cyst, is formed about the young worm, which gradually elongates in a close coil to a length of several inches, and takes on the larval form known as *Cysticercus fasciolaris* in which condition it remains, so far as we know, until the rat is eaten by a cat, whereupon the larvae complete their changes, becoming in the cat's intestine the perfect egg-laying *Taenia*. The yellowish white cysts in the rat's liver grow with the growth of the worm until they are often as large as a cherry, but even when there are several to many they do not seem to injure the rat very much unless a sarcoma develops.

Recently the experimental study of this disease has been undertaken in a large way by Bullock and Curtis at the Crocker Institute for Cancer Research in New York with striking results (Proc. N. Y. Path. Soc., Oct.-Dec., 1920). At the present time they have several thousand rats which have been fed with the eggs of this tapeworm and all of which presumably are infected. The experiment has been going on only about three years but from these rats during this short time more than 250 typical malignant sarcomas of the liver have been obtained, many of them showing numerous metastases to the omentum, lungs and other organs.[4] I have never seen a more remarkable collection of illustrative material, nor do I think there is a more interesting experiment going on anywhere in the world at the present time. It is unfortunate that so little money should be available for this and similar important undertakings. Rich men offer large sums for cancer cures only to be overwhelmed with fraudulent claims, but the men and women who are devoting their lives to researches likely to throw light on various phases of this difficult problem, and working desperately hard, are left to get along any old way. I know five or six places in this country where a few thousand dollars is very much needed and would help cancer research amazingly.

These rat sarcomas always begin in the cyst-wall, that is, in close proximity to the feeding *Cysticercus* and the close-fitting cyst-wall is subject, of course, to all its bitings and excretions. Once started the sarcomas grow very rapidly, are palpated without difficulty and soon destroy the animal. There is the closest relation between the worm and the tumor but there are several very curious facts in connection with the disease which are hard to interpret on any other hypothesis than that formulated by Borrel, who says:

"Le cysticerque n'est donc pas le parasite du cancer, il ne peut être considéré que comme le porte-virus, l'agent d'inoculation de quelques microbes que nous ne connaissons pas encore. * * * * *

"Demodex, cestodes, nématodes, sclérostomes, ne sont pour nous que des agents de localisation; ils sont dans d'autres cas remplacés par: brûlures, corps étrangers, lésions ulcéreuses, agents physiques ou chimiques capables de préparer le terrain à un virus cancéreux, et ce terrain lui-même lorsqu'il s'agit de cancers épithéliaux n'est réellement préparé et apte à être ensemencé qu'à partir d'un certain âge."

These curious facts to which I have referred and which appear to sustain Borrel's hypothesis are: (1) The rat's liver may be full of cysts (a dozen or more) each containing the parasitic worm, and yet no sarcoma may develop; (2) when the tumor does appear, it occurs not in each one of these worm-irritated cysts but as a rule only in one; exceptionally in two or three, very rarely in four or five; (3) the beginnings of the sarcoma are even very much more restricted than this would indicate in that only one small area of the cyst wall or at most a few small spots are at first involved. Moreover, while Bridre saw the Cysticercus in 8,000

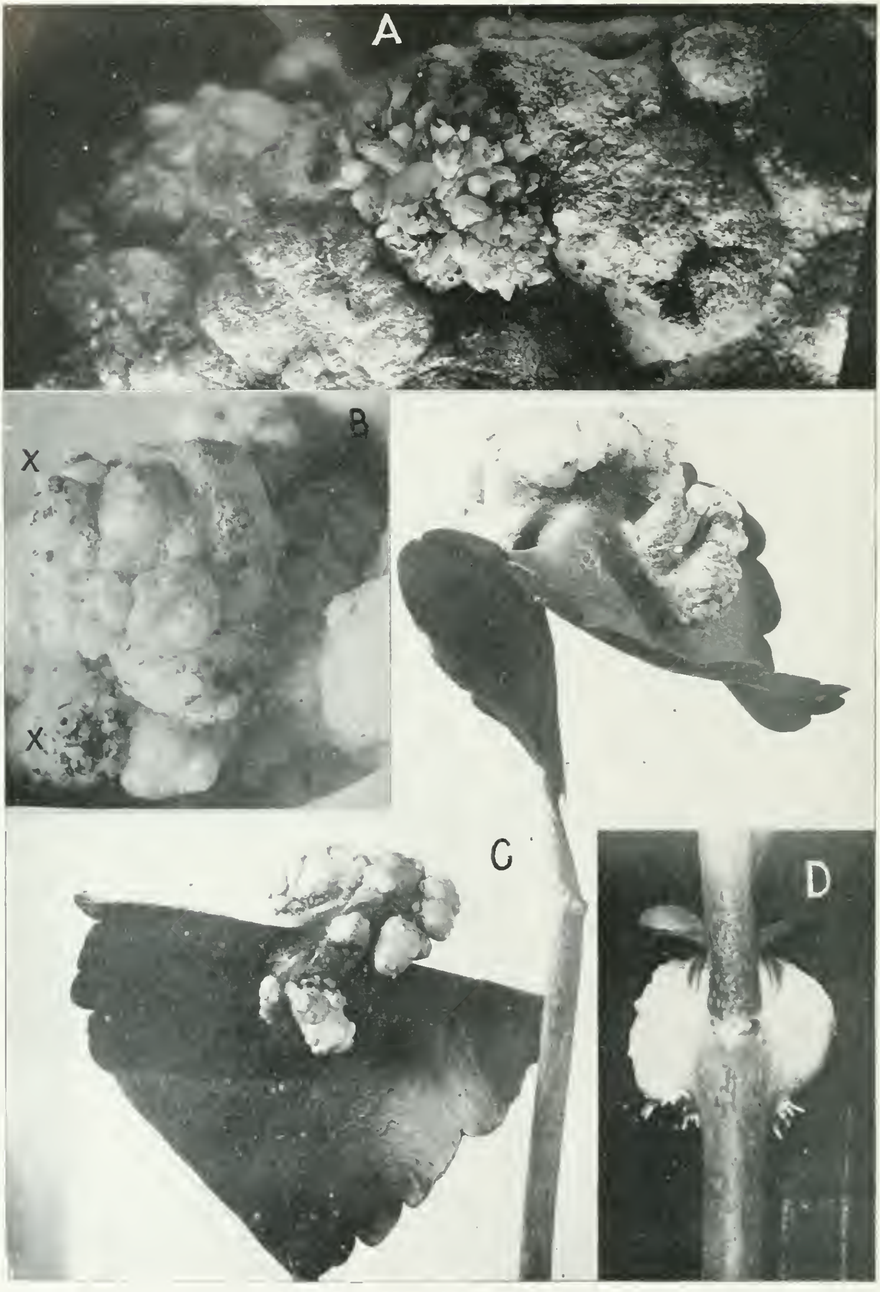

Fig. [illegible] Crown-galls of **Bryophyllum calycinum** showing abortive shoots, abortive roots, and distortions of leaves due to the growth of the tumors. Hop strain. Needle prick inoculations of 1920 and 1921.

A—Bunch of dwarfed shoots in an axillary tumor. Inoculated May 14, 1921. Photo, Aug. 15, 1921, x5. Only about one fifth of the tumor is visible. **B**—Groups of roots at **X X** in a midrib tumor. Inoculated June 23, 1920. Photo, Nov. 18, 1920, x5. **C**—Leaflets showing distortions due to midrib tumors. Inoculations of 1920. Natural size. **D**—Roots developing from an axillary stem-tumor. [illegible] about two months. Photo, June 4, 1920.

For further evidence of effect of crown-gall stimulus on Bryophyllum see Jour. Agr. Research, July 1, 1921, and for M. Levine's paper see Bull. Torrey Bot. Club, [illegible] No. 11, 447-452, 1919.

rats out of 20,000 examined, (Borrel) he observed only 20 cases of the sarcoma. Had these worm-infested rats been held in captivity for some months he would undoubtedly have found a much larger number of sarcomas, but all this being admitted, the great mountain fact squarely in the way of those who would explain the sarcoma as due directly to the activities of the *Taenia* is that out of thousands of liver cysts only a very limited number even in susceptible rats develop the sarcoma whereas every one of the cysts encloses a parasitic worm and is exposed so far as we know to the same verminous irritation.

The fact that all the *Taenia* eggs used in the experiment at the Crocker Institute have been obtained from the feces of one cat are not an insuperable objection to Borrel's hypothesis for several reasons: (1) assuming the virus to come from the *Taeniae* some eggs might carry it and others not—all Anopheles do not carry the malarial parasite, all Stegomyia do not transmit yellow fever; (2) the virus might be encountered first in the rat's intestine, free, and then, if not very abundant, it would be carried in by some larvae and not by others; (3) the virus might not be present at all in the digestive tract of some rats and then there would be no sarcomas no matter how many cysts; suppositions which correspond very well to the observed facts. On the other hand, if the sarcoma is due directly to the poison of the *Cysticercus* either it must be variable in its nature or else more abundant in the sarcomatous cysts, which would mean a larger worm.

Early extra cystic tumors have not been observed by Bullock and Curtis. Of the 85 cases reported on by them in 1920 metastases were distinguishable in the gross in 52. Other statements from Bullock and Curtis are as follows:

Young rats are most susceptible. Ninety per cent of the 43 tumors tested were transplantable. One strain of 600 rats was discarded because of its great resistance to the *Cysticercus* infection. The tumor-bearing rats, moreover, were nine and one-half to eighteen months of age, of both sexes and of five strains. The larvae in the tumor-bearing cysts were usually alive—always unless necrosis had supervened.

"All the tumor-bearing rats presented multiple cysts in the liver, varying from 6 to 84 in number. In a high percentage of these animals only one of the cysts was primarily involved in the malignant process." (Bullock and Curtis, l.c., p. 168.)

V. Experimental Coal Tar Cancers

These experiments grew out of the long observed and often recorded fact that cancer is prone to develop on special types of irritation due to prolonged contact with tar or soot or some of their products (Tar-workers' cancer, Chimney-sweeps' cancer, etc.) Numerous cancer workers in the early part of this century treated the skin of experimental animals for several weeks or months with coal tar in the hope of producing cancer, but all of these experiments failed, apparently because they were not continued long enough.

a. Experiments of Yamagiwa and Ichikawa

Beginning in the autumn of 1913, Dr. Katsusaburo Yamagiwa, a former student of Rudolph Virchow, founder of the Japanese cancer journal, Gann, and professor of general pathology and pathological anatomy in the University of Tokyo with Doctor of Vet. Med. Koichi Ichikawa, also of the Pathological Institute of Tokyo, continued with great pertinacity several series of coal tar paintings some of which finally resulted positively. The immediate incentive to this work is said to have been the brilliant success of Fibiger's cockroach-nematode rat feeding experiments already detailed. They selected rabbits as their experimental animal and finally settled upon coal tar as the best substance to use. This was put on rabbits' ears, an organ peculiarly free from any suggestion of carcinomatous growths. By painting the inner or outer surface with coal tar every second or third day for a year (more or less) they finally obtained many papillomas (called by them foliculo-epitheliomata or hair follicle cancroids) and a few undoubted keratinizing carcinomas of a mild type (Mitt. aus der Med. Fak. d. Kaiserl. Univ. zu Tokyo. Bd. XV and XVII). Menetrier and Surmont in Paris have obtained the same results (Bull. de l'Asso. fr. p. l'Etude du Cancer, Dec., 1922, and Jan., 1923.)

b. Experiments of Tsutsui

In 1918 Dr. Hidejiro Tsutsui, professor of general pathology and pathological anatomy in the medical high school in Chiba, reported that he had obtained similar results on mice (Kuenstliche Erzeugung von Cancroid bei der Maus, *Gann*, 1918, Bd. XII, pp. 17-21.)

Tsutsui used stone-coal tar and English mice, painting the skin of the back every three or four days with a Japanese writing brush. His seven experiments included 259 mice, 192 of which died before the 100th day, apparently poisoned by the tar as a result of licking the painted spot, and these are not counted in the results. The response to the paintings at first was loss of hair, and a smooth, injected appearance of the skin. In time, the spots became hyperkeratotic, rough, dry and scaly. Those mice that lived for more than 100 days developed warty and knotty tumors with the structure of benign papillomas but the base of some of these became transformed into invasive carcinomas of the cancroid or horn-tumor type and lung metastases were observed in two cases. The longest painting was 166 days. Of the 67 mice which survived the paintings more than 100 days, 16 developed carcinomas and one a spindle-cell sarcoma.

c. Danish Experiments

Fibiger then commenced a series of coal-tar paintings on white mice the results of which he published in 1921 (Biol. Meddelelser, III_4). His results are entirely confirmatory of the preceding and leave no doubt that cancer will develop in a certain proportion of coal-tar-painted mice if the experiments are continued long enough. He got nothing definite until after many days. In two of Fibiger's cases he observed metastases in lymph glands, and in two cases the tumors were transplantable. The malignant tumors obtained were either typical keratinizing carcinomas or mixed carcino-sarcomas. They bore no definite relation to the amount of inflammatory reaction.

d. Dutch Experiments

In November 1921, Dr. Deelman, director of the Leeuwenhoek laboratory in Amsterdam, communicated (Ned. Tijdschr. v. Geneesk.) the results of a series of coal tar paintings on white mice begun after the publication of Tsutsui's experiments and before Jensen had published.

He depilated the skin of the back with Beyersdorff's depilatory and tar-painted the naked skin three times a week for many weeks. Nothing was visible for two and one-half months. After that redness appeared and papillomas or small flat spots developing as ulcers. At first the tumors were benign in structure but subsequently they became malignant. The malignant tumors appeared in two forms—direct as carcinomatous ulcers or the same with a papilloma as a preliminary stage. Deelman obtained both carcinoma and sarcoma and the latter he was able to transplant through 11 generations. Good illustrations are given showing the progressive stages of the disease on several mice and the appearance of the carcinomas and sarcomas in section under the microscope. Invasion, destruction of surrounding tissues and metastases were observed. His 48 treated mice were divided into two equal lots: one lot was painted with coal tar from a horizontal apparatus and the other lot with tar from a vertical apparatus. Both tars produced cancers but tar from the vertical apparatus was very much slower in its action. Some of his mice died early and there is no statement of the per cent that developed cancer, but because of this omission we may assume it to have been small.

Dr. Deelman has published three additional papers (Klin. Woch. Jahrg. 1, No. 29 and Ztschr. f. Krebsforsch Bd. 18 and 19.) The most important new thing he has discovered is that, in early stages, tar cancer in the mouse grows by *apposition* as well as by *invasion*, that is (1) *aus sich heraus*, and (2) horizontally in all directions by "cancerous conversion" of the surrounding epithelial cells. Deelman's observations rest on a wealth of material, viz., on 62 tumors sectioned in series from the backs of 18 tar treated mice, all in early stages of growth. He is also positive the cancers begin at the same time in many cells and are often multicentric. In other words, he rejects Ribbert's views and sides with the majority (See my summary of earlier views pro and con in J. Cancer Research, 7:No. 1).

e. *English Experiments*

(I.) The English experiments of Murray and Woglum (7th Sci. Rep. Imp. Cancer Res. 1921) are confirmatory of those already recorded. A series of 190 mice from 3 to 6 months old were coal-tar painted in a line 1 centimeter long and 1 millimeter wide between the shoulders once or twice a week for variable periods after removal of the hair by barium sulphide paste (10 per cent sodium sulphide in water is recommended as a less poisonous substitute).

The animals were critically examined every two weeks. The initial lesions were sessile or pedunculated warts, cutaneous horns or scabby ulcers. In alternate animals the tarring was discontinued when the hypertrophies appeared. The tarring was discontinued also in the others when the growths showed signs of rapid increase in size. Some tumors which structurally could not be identified as carcinoma were autotransplanted and in this way determined to be malignant. Many animals died early of intercurrent diseases. Twenty-three developed cancers. Many of these tumors invaded and metastasized and returned after wide excision. Those mice which developed cancer received from 30 to 103 paintings, the average number being about 70. Some animals responded quickly, others only after many treatments, the time of appearance of definite malignancy varying from 16 weeks to 52 weeks. These tumors had the structure of polymorphous squamous cell carcinomata with slightly developed keratinization. Three of the tumors were successfully transplanted to normal animals. With tumor 1614 no growth was obtained in 10 normal animals although both autoplasts had grown rapidly. In this tumor and both autoplasts the growth consisted almost entirely of a spindle cell tissue with very sparse islands of keratinization. They thus obtained a structure resembling sarcoma but the real nature of which remained in doubt because transplants failed.

They say:

"It would appear that the longer it takes to set up the malignant change the more atypical the growths will be." (p. 58).

To me the most significant features of these experiments are the successful use of autoplastic transplantations for determination of doubtful malignancy, and the fact that in no case was a diffuse carcinomatous change produced over the whole stimulated area but only in isolated small foci, as if due to some secondary cause.

Concerning the latter point they say:

"In the majority of instances a single nodule appeared. In six or seven, two or three nodules were produced and coalesced. In two instances * * * several nodules appeared distributed along the irritated area. This can only mean that the neoplastic change is not an immediate response to a single chemical substance present in the irritant but is produced indirectly by secondary changes in small foci in the stimulated area." (p. 60).

(II) According to Archibald Leitch, director of the Cancer Hospital Research Institute, London (Brit. M. J., Dec. 9, 1922, p. 1101), a long time elapses after the beginning of tar treatment before there are any visible signs of tumor formation. In mice the beginnings are not until near the end of the third month. Previous to this there are no specific characteristics which can be labeled as precancerous. In the living mouse deep infiltration can be appreciated by the fingers after a time.

"In some of our former experiments we stopped the application of tar as soon as basal induration was evident, and we found that nevertheless the tumors went on growing with undiminished rate; the removal of the irritant did not arrest the process when once the malignant stage was reached. The failure, therefore, to detect a causal agent in a cancerous growth cannot be held as proof against the previous existence of such."

In 15 mice on which the tar treatment was stopped after four and five months and 14 of which had had small warts in evidence for a few days up to a month and another an open ulcer, the subsequent results were as follows: In 5 cases the papillomas disappeared, in 3 the warts remained simple, 1 remained doubtful (it died and was eaten by other mice) and 6 became malignant.

In a second batch of mice the tar painting, three times a week for four or five months, was discontinued before there was any sign of tumor formation. At the time the tar painting was discontinued there were 20 mice remaining with no visible sign of neoplastic reaction. The subsequent results were as follows: 6 remained negative till death, 4 developed temporary warts, 4 developed simple papillomata and 6 developed malignant tumors. The negative cases lived 29, 42, 43, 48, 65 and 75 days after the painting ceased.

In a few cases Leitch also obtained malignant tumors by painting mice with paraffin oils (crude and more or less refined shale oils), and two of these were sarcomas.

f. *Additional Danish Experiments*

In July, 1922, Dr. Fridtjof Bang of Copenhagen reported to the Societe de Biologie in Paris that he had undertaken a new series of tar treatments on mice, continuing the work of Fibiger and Bang in which he had used 263 mice in 15 different series of experiments from which he had obtained 22 beginning carcinomas and 93 fully developed ones. Among the latter, five were complicated by fusocellular-sarcoma. Those mice kept in the dark developed cancers as rapidly as the others and the evolution of the disease was the same. He observed visceral and lymphatic metastases in 25 per cent of the cases and one of the metastases was a carcinoma-sarcoma. The metastases continued to develop after removal of the primary cancer.

In five series of paintings which lasted four months and more, those mice which died before the sixth month were not attacked by cancer. Of the rest, (77 in all) 97.4 per cent became cancerous, i. e., all but two.

"I have observed during more than a year mice painted with tar for periods ranging from one month to four months with results as follows:

14 mice painted one month; none carcinomatous.

16 mice painted two months; 3 carcinomatous.

13 mice painted three months; 9 carcinomatous.

12 mice painted four months; 12 carcinomatous.

The importance of continued application becomes apparent from this table."

The painted skins of 45 mice, living or dead, have been examined in section from which it appears that the hyperplasia begins very early but that without exception the infiltration commences only after at least four months of continued application of the tar. In exceptional cases of rapid development we must admit an individual predisposition. If the painting is continued only during four months when it ceases the deep infiltration is rare. Nevertheless, in the course of the following months the cancer fatally appears. Formations that are histologically benign may be, therefore, biologically malignant [See also Murray and Woglum] and only manifest their malignancy at a later date when the growth becomes invasive and destructive. Such growths are latent carcinomas. By the term latency he means the time that intervenes between the time when the painting has rendered the cells biologically malignant and the moment when the

invasive growth begins, the paintings having meanwhile been suspended.

Since mice painted during only one month escape cancer and those painted during four months invariably develop a malignant tumor, we may estimate the duration of the paintings necessary to produce this transformation of tissue at about two to three months. In most of these mice the development of the carcinoma is slower to appear than in those which have been painted four months. As a matter of fact, in the former it develops only eight or ten months after the beginning of the tar treatment while in the latter it manifests itself six or seven months after the beginning of the treatment. The longest time of latency he has observed was in a mouse which was tar painted for two months and died cancerous 317 days after the beginning of the paintings. Here the period of latency was about eight months. Inasmuch as mice painted four months or more show cancers after six or seven months (the longest time was 235 days) we must admit that the period of latency may be shortened by continuing the paintings after the biological transformation of the cells into malignant elements has taken place. The tumors can be obtained on very young mice with the same frequency and same rapidity of growth as on older mice. (Comptes Rendus des Seances de la Societe de Biologie, Paris. 22:754-757. July, 1922.

In a second paper read at the same time Bang states that the tar provokes an immediate intense proliferation of the epithelial cells so that the two layers of the normal epidermis give rise to several cellular layers. As determined by the examination of a great many sections in series the abnormal process takes place in the following order: thickening of the epithelium after one or two paintings; epithelial cysts about the tenth day; earliest formation of papillomas about the 29th day, but frequent only after two or three months, and visible to the naked eye only after four or five months; after this begins the epithelial invasion. In the course of the first month of paintings during which there is an epithelial thickening in full development no hyperplasia of the connective tissue is observed. Later this also takes place. After tar paintings continued for four months and more papillomas are always produced, which later are followed almost invariably by cancers.

The biological malignancy of the hyperplasial epithelium is accompanied ordinarily by a hyperplasia of the connective tissue.

All the processes are accompanied by inflammatory and hemorrhagic symptoms.

Some parts of the painted skin are more influenced than others.

In some cases the hyperplasial process tends to regress. In others it may persist to an advanced age without resulting in cancer.

"The decisive factor in the development of tar cancer is not, therefore, to be sought simply in the combined epithelial and connective tissue hyperplasias, not even when these hyperplasias end in the formation of papillomas visible to the naked eye. The hyperplasial processes are followed by carcinoma only in cases in which a more prolonged painting has given to them a biological malignancy." (l.c. pp. 757-759.)

Discussion.

Are the irritation tar cancers flatly contradictory of parasitism? Yamagiwa seems to think they are. I am less certain.

The tar treatments involve a long-continued open wound subject to and inviting all sorts of infections, so that if there were a cancer parasite in the environment of any of these animals, either in the soil, or in the litter, or on its food, or on its skin, or on the walls of the cage, or in the dust of the room, or on the hands of men handling the wounds, or in or on any of the common skin parasites of these animals, it would be more or less certain to find lodgment and a very favorable nidus in these irritated raw places. The general impression one gets from the tar cancer experiments, so far detailed, is that it requires great labor and patience to produce positive results, and these results, which cannot be denied but which may be interpreted in different ways, are fewer and less striking than one might expect if the tar itself is their sole cause. In the first Japanese experiments of Yamagiwa and Ichikawa papillomas were finally obtained in 32 out of 52 painted ears, but only 3 cases of infiltrating carcinoma were observed and no metastases (1916). In their additional experiments described in 1917 they report 8 cases of carcinoma from 45 experimental animals with 2 lymph node metastases, and 5 cases of "beginning carcinoma." White rabbits were least susceptible (1 case in 13) and black and gray-black rabbits, most susceptible (100 per cent), but only 3 animals were under treatment. For the animals as a whole and reckoning the 5 "beginning" cases with the 8 typical carcinomas we have 13 cases only from the 45 animals after treatment extending over many months.

In their 1918 paper (J. Cancer Research) they report use of 137 rabbit ears (four series) with production of seven complete carcinomas, 16 in an early stage and 8 in earliest stage.

In Tsutsui's experiments, as we have seen, he obtained 17 cancers in 259 mice, or in 67, excluding those which died before the 100th day.

The total of Fibiger's three series on mice is somewhat better, viz., 24 cases of carcinoma (or carcino-sarcoma) in 45 animals, and Bang's are still better, but mice, especially old mice, and mice of certain breeds, are much subject to cancers in the absence of tar painting. Possibly, therefore, some other cause may have been at work besides the tar treatment, e. g., some organism able to enter and infect a long continued open wound. Fibiger gives for his three series where the treatment was continued for 180 days, or longer, 24 cases out of 26 animals, and Bang 75 out of 77, which is all that one could ask, but Dr. Marsh and Miss Slye have both bred races of mice in which 100 per cent become cancerous as they get old, without any tar treatment, and Miss Slye tells me that these cancers often begin in accidental wounds. When from the tar we have a definite chemical substance by means of which cancers can be produced early in life in 100 per cent of cases, as can be done with crown-gall bacteria, then we may believe that cancer can be produced in the absence of parasites and we shall be one step farther advanced toward the solution of the vexed problem of its etiology. Parasites will not have been eliminated thereby in all cases, but we shall know definitely that any substance capable of acting on the cell in the same manner as the excretions of certain bacteria and of certain worms or their symbionts will bring about the same results.

Yamagiwa's additional experiments on the breasts of rabbits are still less conclusive: 31 coal tar injections into the breasts of 200 rabbits with only one cancer (a fibromyxosarcoma with metastases) at end of 23 months (M. a. d. Med. Fac. Univ. Tokyo, Dec. 28, 1920, 25, 2). Seedorff, who repeated this experiment on 39 rabbits, 8 of which survived one year of treatment, failed altogether (1922).

g. *Swiss Experiments with Coal Tar Distillates*

Recently an attempt has been made by Bloch and Dreifuss (Sch. Med. Wochenschr. Nov. 10, 1921) to isolate the active principle from coal tar and these efforts if we may believe the preliminary report have proved remarkably successful and will greatly advance our knowledge.

They began work in 1920 using rabbits, with the same results as Yamagiwa (number not stated); guinea pigs, which proved resistant; and white mice, which yielded results "exceeding anything hitherto obtained." Raw tar was used only on a small part of the animals. All the fine results were obtained with a definite fraction of the coal tar, produced by distillation. Corresponding to English observations on

the variable number of cancers in men who handle various kinds of coal tar products (H. C. Ross, J. Cancer Research, 1918) the bases, phenols and hydrocarbons, which come over at low temperatures, were found to be negligible. With the first two nothing was obtained and with the low-boiling hydro-carbons only mild results which first appeared after many days. On the contrary with a product which distills over above 300° C. and is soluble in benzol, astonishing results were obtained. With such a distillate they state that they were able to produce skin cancers on mice in four months' time in 100 per cent of the cases (number not stated nor strains or age of mice employed). Their technique was the same as that used by Yamagiwa. The substance used was painted on the back of the mouse toward the tail every other day for 160 days or more. After a variable time the treatment was discontinued. Except such animals as were killed early for study, the mice lived from 150 to 250 days after the beginning of the experiment, and a few lived longer, dying with signs of cachexia. Photographs of two mice shown were made on the 207th and on the 217th day.

The macroscopic clinical changes in the mice were as follows: After about five months, seldom earlier, tumors appeared here and there on the skin, which early lost its hair. They were at first only of pin-head size but grew rapidly. They often resembled flat warts, but soon became rounded with a broad base. The arched surface generally showed early a fine, rough-horny verrucosity. The number of these tumors varied greatly. On one mouse there were 22. Some of these tumors receded and others fell off, but most of them continued to grow. After a while the growth was much more rapid not only peripherally but also in the depths. Sometimes from the beginning superficial flat erosions appeared instead of raised tumors. Thus the development of the tumors was in two directions but there were mixtures of the two forms. One of these forms greatly resembled many basal cell carcinomas of the human skin. The other, which appears to have been the more common form, was characterized by the presence of horny masses which were sometimes several centimeters long. Under these hard, horny masses was a bleeding papillary ulcus. Most of these tumors, like the preceding, were surrounded by a thick, firm, pale, non-ulcerated edge. In spots in both forms there were strong inflammatory reactions and even pus.

The most important fact in connection with these tumors is that after the treatment ceased they continued to grow both on the surface and in the depths. This further growth was sometimes very rapid, producing ulcerated and hyperkeratotic tumors several centimeters in diameter and in height.

These new formations destroyed the subcutaneous tissue, penetrated into the muscles and even through the wall of the peritoneum. When they lay near the backbone this was strongly twisted. In one case the bony tissue was also attacked and the tumor reached from the insert of the tail to far down on the thigh. Metastases were observed in the axillary and the inguinal glands. These glands were swollen, reddish, succulent and showed plainly the tumor tissue even to the naked eye and strikingly under the microscope. Still more frequent and interesting were metastases in the lungs. They appeared in various lobes in the form of conspicuous white, hard, red-bordered nodules from the size of a pin head to a pea. More than 20 such were seen in the lungs of a single animal and a microscopic examination showed that many more were present. These lung metastases were relatively frequent being found in 30 to 40 per cent of the older animals. The behavior of the connective tissue was inconstant. A definite relation of the epithelial proliferation to the grade of inflammation could not be made out. The principal changes were in the skin. The early stages were benign (gutartige) acanthoses and hyperkeratoses, but gradually or suddenly the picture changed to one of invasion and metastasis and epithelial pearls were very frequent in the invasive strands. For a time these tumors respect the muscles but then break through. The tumor is histologically a cancroid and resembles the type *carcinoma solidum*.

"Mit dieser Substanz konnten wir in relative kurzer Zeit (ca. 4 Monate) in 100% mächtige, ausserordentlich rasch wachsende und maligne Tumoren hervorrufen."

The authors publish good, convincing figures. The fractioning of the tar was done in conjunction with Dr. Labouchere and another paper is contemplated. They do not name the substance and perhaps have not yet determined it, but it must be one of the many associates of crude anthracene. Purified anthracene, judging from factory experience in England (O'Donovan) appears to be harmless, but among English factory workers in crude anthracene, keratoses are very common and they often end in cancers.

h. English Experiments with Extracts

(I) Dr. Murray says (Brit. M. J., Dec. 9, 1922):

"I have found that an extremely active extract can be prepared from tar by successive extractions with water, alcohol, and ether. The ethereal extract gave 50 per cent malignant growths in twelve months, reckoned on the total number of animals that survived for four months."

(II) Dr. R. D. Passey, of Guys Hospital, London, has also confirmed experimentally the production of malignant tumors by soot extracts (Brit. M. J., Dec. 9, 1922, p. 1112-1113). He tested three extracts of coal soot made as follows:

I. Simple, repeated ether extracts concentrated to a syrup. The water extract of this was faintly acid.

II. Three parts of soot and one part of quick lime intimately mixed, stirred into a thick paste with distilled water and spread on a glass plate in thin layers to dry. This mixture gave off ammonia freely. When dry it was broken up and repeatedly extracted with ether till the washings were a light sherry color. It was then filtered, the ether distilled off and the residue stored for use. The water extract of this was faintly alkaline. Neither I nor II were soluble to any great extent in water.

III. One part of II was added to 10 parts of N/10 HCl. and shaken thoroughly in a separating funnel. This washing was repeated with fresh additions of weak acid till the extract was nearly colorless. The bulky, strongly acid water extract was then filtered and rendered slightly alkaline with N/1 NaOH. This caused an oily yellowish precipitate. This was repeatedly extracted with ether which was then distilled off. The water extract of the residue was feebly alkaline.

Young adult, white mice were then painted repeatedly for a long time with each residue—20 with I, 40 with II and 20 with III. Applications were made along the back over an area 2 cm. by 5 mm. two or three times a week after removal of the hair by means of barium sulphide, the thick extracts being diluted with a minimum of ether for ease of application. Nos. I and III were found to be negligible. The former produced warts in only three animals by the end of six months and the latter in only one animal and neither caused definite malignant changes. On the contrary, II produced cancers. This substance which contained the basic and neutral ether soluble fraction was brown in color and of the consistency of very thick treacle.

The painting with II began Dec. 16, 1920, and the first wart appeared in ten weeks after 31 applications. By March 18, 1921, 16 mice had developed warts (the survivors at this date were 18) and at the end of the third month 50 per cent of the then suviving mice (number not stated) subsequently developed malignant tumors. The first case of malignancy was established microscopically June 12, 1921.

Subsequently two groups of mice of 50 each, as nearly identical in size and

color as possible, were painted with II, in the same manner, but were fed differently. One group (A) received a diet rich in fat-soluble vitamin A and the other group (B) a diet poor in fat-soluble vitamin A. The only visible difference was that the warts appeared a little earlier in B. Of the survivors at the end of the fifth month (number not stated) 42.3 per cent developed malignancy in A, and 47.3 per cent in B. Forms suggesting sarcomata also occurred, but were considered to be carcinomata.

"Malignancy was determined (1) where possible by autoplasty, as suggested by Dr. Murray; (2) by secondary deposits or recurrence after wide excision; or (3) by deep invasion of muscle where the animal had died before 1 and 2 had time to occur."

VI. Anilin-Dye Cancers

Various anilin compounds have been under suspicion for a number of years as the cause of bladder and other malignant human tumors. The first reported case was at least as far back as 1895.

a. Scarlet Red

In 1906 Bernhard Fischer reported on some remarkable results he had obtained by injecting rabbits' ears with olive oil saturated with scarlet red (Muenchen m. Wchnschr. Nr. 42). Under this treatment the epithelium began to grow, thicken and send down groups of invasive cells into the deeper tissues with development of abnormal mitoses, pronounced keratinization of the surface layers, and the formation of many epithelial pearls in the deeper invasive masses of the epithelium, quite after the manner of skin cancer. These results were obtained only by injection: they could not be obtained by painting the surface and the growths ceased when all the olive oil was absorbed.

Following Fischer's publication, which excited a good deal of interest, many persons repeated his experiments, but after some years there was a general consensus of opinion among oncologists that the epithelial proliferation, although remarkable in many ways, could not be considered as a cancer because it always receded soon after the treatments ceased. Here apparently, as in case of the coal-tar treatments, the failures were due to lack of persistency on the part of the experimenters, since in 1918 Yamagiwa and Ohno reported success with scarlet red dissolved in olive oil when injected into the wall of the ovary in hens (Gann, Bd. XII, S. 3). Their experiments began in December, 1914. They used 41 sound chicks or hens, injecting the fowls 1 to 5 times at intervals with a laparotomy in each case. They made 3 series of experiments—(I) 12 hens from which they obtained 1 case of multiple adenocarcinoma, (II) 9 hens, yielding 1 case of gland carcinoma with metastases, (III) 20 hens from which they obtained 1 case of gland carcinoma with dissemination. I have read only the brief German abstract of their first Japanese paper (prepared, however, by Yamagiwa). To be entirely convincing this work should be repeated since the percentage of cases is small and perhaps not beyond the limits of error, although the authors believe it to be so.

b. Sudan III.

In 1918 (Gann, Vol. XII, parts 3 and 4) Dr. Nobumasa Umehara, professor of general pathology and pathological anatomy in the medical high school in Kyoto, added another link to the preceding chain of evidence.

He had obtained a knotty tumor, from the breast of a white rat, which structurally was an adenofibroma. This he was able to transplant to other white rats through 14 generations with a constant structure except that toward the end the connective tissue increased in amount and the gland tissue decreased correspondingly. The number of takes were also less toward the end. For these transplants he used 423 rats with 144 positive results. This tumor grew expansively to a large size but there were no metastases and there was no infiltration. Even when the tumor equaled or exceeded the weight of the rat there was no cachexia, but only nutritional disturbances ending in death.

Umehara then tried the effect of repeated injections into the tumor of the following substances: (1) 2% aethyl alcohol; (2) 1% cholesterin in olive oil; (3) 1% scarlet red in olive oil; and (4) 1% Sudan III in olive oil. The results with the first three substances were negative.

Of three rats injected with Sudan III one died after the eighth injection with no change in the nature of the tumor. Of the other two each of which received 17 injections, one lived until the 42nd day and the other until the 57th day. Both developed tumors as large as goose eggs. A part of each tumor repeated the well known adenofibroma structure but the rest and the major portion consisted of a gray-red translucent bloody mass with many necrotic spots. Under the microscope this part was sarcomatous, consisting of rapidly growing spindle cells, round cells and giant cells. Many mitoses were present. This sarcoma was transplanted through 14 generations. It grew expansively, invaded and metastasized, caused cachexia and killed. For these transplants 445 rats were used of which 291 gave positive results. No bacteria or other parasites were found in the sarcoma and injection of dead cells or the juice of the living cells did not cause the tumor. The tumor could not be transplanted to other experimental animals nor easily into parti-colored rats (black and white).

Conclusions

What goes on inside a cancer cell that does not go on inside a normal cell? If we knew that we should be very near the solution of the cancer problem, and it is not beyond hope that eventually we shall know just that—chemically and structurally. We must conclude that the cell or its progenitors has been under a foreign stimulus of some sort. Everything we know about cancer points to this conclusion. In case of the crown-gall bacteria, acid and alkaline by-products are given off in simple culture media and we have a right to assume that they are also given off inside the plant where similar proteids and sugars are at their disposal. When applied to the surface of the plant these substances set up chemical and physical changes which lead to an excessive, disordered, hyperplasial growth and they probably do this in the tissues where they are produced by the parasite, but here our knowledge ends.

It may be that some element of the cell or of its environment which ordinarily acts as a break on cell division is destroyed or weakened by the action of certain physical and chemical activities (x-ray burns, common burns, arsenic, cobalt, tar products, products of worms[5] and of bacteria) and so we get a cancer, that is, a cell-multiplication passing beyond physiological control.

The reason some worms cause tumors and others of the same origin (cat, cockroach) do not might be explained in at least any one of three ways: (1) The tumors that start first might absorb most of the nutriment and many other beginning cancers fail to develop for this reason. In many plants the buds which first develop exert an inhibiting influence on other buds. Destroy the former and then the latter will grow. (2) The individual larvae might excrete varying amounts of virus and the more virulent ones be those which cause the tumors (Fibiger's idea.) Some bacteria are known to be exceedingly variable in the amount of poison they produce and also some of the higher plants, e. g., digitalis. Why not also nematodes and tapeworms? (3) Some of the worms from the same individual (cat, cockroach), and this is the concept I have favored in this paper, might carry a living cancer germ (protozoan or bacterial) and others not, depending on the particular segment of the mother worm from which they originated. It is easily conceivable that some egg-laying segments of the mother worm and eggs from such segments might be infected and other segments and eggs not infected. Recently in the United States (J. Parasitology, March, 1922) Kudo and Heth-

errington have shown that a parasitic nematode (*Protosirura muris*) of the common house mouse harbors a protozoan in the epithelial cells of its intestine. This is a new species of microsporidian. Also in the Laboratory of Zoology and Comparative Anatomy in the University of Geneva, Switzerland, Guyenot, Naville and Ponse have found a microsporidian parasitic in the larvae of a Cestode living as a parasite in the sub-cutaneous conjunctive tissue, the muscles and the peritoneum of an adder (*Tropidonotus natrix L.*) coming from Italy. They find this microsporidian, which occurs with great frequency (89 per cent) is parasitic also in the tissues of the adder where it causes cellular reactions. (C. R. Soc. de Biologie, Paris, Seance du 22 juillet 1922, p. 635-637.)

One would think if the excessive growth were due only to a temporary depression of some function of the cell this would disappear and the malignant growth cease with the disappearance of the cause, just as normal growth ceases when the physiological stimulus is removed or counteracted, but if some growth-inhibiting element of the cell is permanently weakened or destroyed within certain cells then, just as we have bud-variation in animals and plants, unexplained as yet but reproducing itself, so we might have a disordered growth which would continue indefinitely in the descendants of such cells after the disappearance of the inciting cause, whatever that cause might be. This is Jensen's idea, and Fibiger's.

What is this inciting cause to a disordered growth? In some cases it seems to be an x-ray burn, the long continued action of soot, of coal tar, of paraffin, of anilin, of cobalt, of arsenic, etc. These are the irritants, it is not yet established that they are the actual cause. Moreover, when all is admitted, these are rare causes. For the ordinary forms of cancer, those seen every day by surgeons and x-ray men, there must be some other and more common cause, or causes. Some have said heredity does it, and certainly heredity plays its part, but I can think of inheritance only as preparing a suitable soil through the weakening of some of the protective forces of the body, and not as the direct cause of cancer any more than it is of tuberculosis. Mouse breeding experiments as ordinarily performed are incompetent to settle the question of the cause of cancer. They are carried on in crowded dirty quarters, almost always with an insufficient number of helpers, and they do not yield the effects of pure heredity, but of a bad inheritance plus the action of ecto- and endo-parasites—of swarms of mites, and nematodes, bedbugs, fleas and what not crawling about and biting and burrowing from youth to age. Until mice can be bred free from what have now become very suspicious complications we shall never know what weight to give pure heredity. Why does not some one breed them clean? I think it would be quite possible to take the young from the mother at birth or just prior to birth and rear them under clean conditions free from parasites and have mice of cancerous lineage remain free from cancer. This is something that can be determined by direct experiment. It offers no insuperable difficulty so far as I can see and it is of immense importance. We bring up babies in incubators, why not mice?

The Cat-Taenia-Rat-Liver-Cyst-Sarcoma experiments at the Crocker Institute seem to put a quietus on the doctrine that heredity is the cause of cancer. They have now been able, the director tells me, to interbreed the sarcomatous rats so as to have strains 100 per cent of which are sarcomatous, *but only if the tapeworm irritant is present.* If it is not present, then the susceptibility to the sarcoma remains latent. Bang in Copenhagen also experimented with this disease some years ago and failed to get any positive results, undoubtedly because he was working with a resistant strain. Very fortunately, after the first failure at the Crocker Institute, the director decided to continue the experiments on other rats, some of which proved susceptible and have given the wonderful results already detailed.

A long continued physiologically wrong course of living, excessive eating and drinking, or chewing and smoking, for example, might also be regarded as preparing a suitable soil for cancer, but hardly as being the direct inciting cause. What occurs here may be the premature aging through excessive stimulation of some of the protective organs of the body enabling a weak parasite to attack and this might occur early in some persons and late in other persons, or never. We must certainly abandon the idea that carcinoma is only a disease of old persons. It is most common in the old but it occurs also sometimes in the young, quite frequently in the middle aged, and as we have seen can be produced in the youngest mice by tar painting. At any age, however, I believe carcinoma is only the last stage in a series of physical degenerations. Probably no one can have cancer who is not ripe for it. Here is a great field for fruitful study.

In the light of the cancer-resembling structures I have found in crown gall, a tumor due to a schizomycete; of the filterable virus Rous has found in three chicken sarcomas; of the cockroach nematode Fibiger has proved to be the precursor of stomach cancer in the rat; of Kopsch's frog tumors due to angleworm nematodes; and of the cat tapeworm Borrel and others have found closely associated with the rat liver-cyst sarcoma and Bullock and Curtis have proved up experimentally on sensitive rats, which, however, in spite of their inheritance, do not develop the tumor in the absence of the worm, together with all the other similar but experimentally less well established cases of acarid, verminous and protozoan association in cancer of men and animals, I think we must predicate the products of parasites or symbionts as the probable cause of most cancers or at least of their initial stages. In some cases perhaps several organisms act together or one heightens the action of another, and some of these organisms or viruses, as Rous has shown, are filterable through Berkefeld bougies and are probably ultramicroscopic, at least in some of their stages.

Whatever we may think as to the cause of human cancer, it cannot be denied that the ability to produce cancer in plants by means of bacteria, in chickens by means of a filterable virus (Rous), in rats by means of a nematode (Fibiger), in rats by means of a tapeworm (Bullock and Curtis), and in rabbits and mice by means of tar (Yamagiwa, Tsutsui, Fibiger, and many others) have so much advanced our knowledge and have so simplified the problem that we may hope for its full solution, so far as regards many forms of cancer, in the not distant future. As I have frequently pointed out, the crowngall organism acts to produce a tumor not mechanically but through its excretions and there is nothing contradictory of my ideas in the fact that cancers may be produced by tar products or by excretions from tapeworms and nematodes. Only I must still believe that the bulk of the evidence we now have points to microparasites as the probable cause of sarcomas and carcinomas. Very curious and instructive in this connection is the fact that many coal tar paintings and many verminous irritations do not end in cancers, and in those which do, *it is not the whole stimulated region that becomes cancerous, but only tiny scattered areas which begin to behave differently exactly as if they had become infected.*

Opposed to this view is the fact that no one has isolated any microparasite from carcinoma and aside from the filterable virus in chicken sarcomas, the nature of which is unknown, the same is true of sarcoma. But these are only negations! They do not disturb me, as I have said repeatedly, because th. par-

asites of tuberculosis, of leprosy, of syphilis, of malaria and of yellow fever remained undiscovered for many years. We were two years trying to isolate the parasite of crown gall yet it is a very simple operation. Think also of the many plainly contagious human diseases, the cause of which still remains uncertain, I need only mention dengue fever, scarlet fever, small-pox and the pandemic influenza; nor need the fact that cancer does not appear to be contagious bulk very largely against this view. Malaria is not directly transmitted from person to person and yet it is due to a parasite. Human carcinoma also may perhaps require an intermediate host and it almost certainly requires for its growth a special, defective bodily condition, either a bad inheritance or a long continued bad environment, or both acting together.

We must expect to continue to find animal and plant parasites with peculiar methods of propagation difficult to discover and to find parasites much smaller than any microorganisms now known to us. There are plant viruses, the particles of which are so small that an ordinary bacterium swimming among them would be almost like a whale among minnows, or a zeppelin among cockchafers. There is an immense leeway for living things between the size of the largest molecules and that of the smallest known organisms. There are many filterable virus diseases in plants and more are being discovered every year. The virus of the tomato streak is exceedingly infectious and sometimes kills in three or four weeks yet we have not been able to isolate any organism. The same is true of the tobacco mosaic and yet the least particle of the juice of a diseased tobacco plant will infect a healthy one, and some of the particles of this virus will pass through a filter with pores only 3/100 micron in diameter (Duggar). We are far from having sounded all the depths of parasitism and of symbiosis in either plants or animals.

I say nothing here about the work of Ford Robertson, John W. Nuzum and others who are now experimenting on animals with bacteria isolated from malignant tumors because the positive results thus far published are too few to be of any value as evidence

If the statements of Bloch and Dreifus are confirmed as to the isolation of a specific cancer-producing substance from coal tar, then the tar cancer experiments will have greatly advanced our knowledge of the etiology of cancer because as soon as we know that keratinizing cancers can be produced with a definite chemical substance we shall begin to make experiments and to get positive results with various chemically (or physiologically) related substances, some of which undoubtedly will be found to be the products of parasites, or symbionts. Coal itself is the product of decay. The symbiotic action of organisms is an almost untouched field in medicine and yet it is one of the commonest and most striking things in Nature, witness the lichen. It is probable, as Ewing has pointed out, that cancer in the broad sense of the term, the way in which I use it, is a complex of diseases with unrelated origins, but certainly we should not expect as many parasites as there are forms, for I have produced in plants at least three forms with one organism, viz., a conjunctive tissue tumor with few vessels, the common form; one with many vessels; and a solid embryoma. We do not yet know positively that sarcomas and carcinomas are not the response of *unlike tissues* to the *same* or *similar* causes. The fact that in a series of mouse-tumor transplantations we may begin with adeno-carcinoma and finally obtain a pure sarcoma points to this conclusion, as does also the occasional appearance of sarcoma in the nematode carcinomas and in the tar cancers. As I stated in my textbook[6] two years ago (p. 511), I regard cancer as a phenomenon of continually interrupted healing. What we have now to determine is whether continually interrupted healing is of itself sufficient, whatever the agent, to cause cancer or whether in some types of the disease, if not in all, the raw surface of the chronic ulcer is to be considered only as the nidus on which a cancer germ or virus may be engrafted. As to this we shall know much more in the near future. The first view is the obvious one but the obvious is often misleading and sometimes the unexpected and strange which no one will believe turns out to be true. We should at least be on our guard against unclean raw foods, especially salads; should see to it that all house vermin, rats, mice, roaches, bedbugs, etc., are destroyed promptly, and should have all sources of irritation removed as speedily as possible, surgically or otherwise. All the histologists should look for worms in or near primary cancers and in each case the whole tumor should be cut and searched.

Finally, the great fundamental advance of the twentieth century in cancer research is the fact that cancers (both sarcomas and carcinomas) have now been produced experimentally, and we have only to correlate our knowledge and extend it a little along the lines indicated to have a definite solution of the whole problem.

To summarize the subject in a few words: The cause of cancer, so far as we now understand it, may be defined as an irritation acting on an organ or organs unable to withstand it owing to a transmitted or an acquired weakness. Heredity alone cannot cause cancer, but irritation (parasitic and possibly also non-parasitic) plus heredity can and does cause it. No such conclusions could possibly have been drawn twenty years ago. They are the measure of the progress we have made.

Footnotes

1. In another room were exhibited photographs and photomicrographs illustrating various crown galls, and specimens showing dwarfing and death of plants due to early terminal-bud inoculations. Some of these are shown on the accompanying plates.

2. Our first papers definitely establishing the cause of the disease were published in 1907 (Science, N. S., 25:671; and Centralbl. f. Bakteriol., 20:89, Part 2.)

3. Recently Riker in the United States and Robinson and Walkden in England have denied this, maintaining that the organism is always between the cells (Phytopathology, 12:55; Annals of Botany, 37:299) and the subject is still in dispute.

4. In December Dr. Francis Carter Wood, Director of the Institute, told me that the count had reached to more than 700 cases and as this paper goes to press the total number of the cases exceeds 900.

5. W. Caspari has recently announced that autolyzed nematode eggs or Taenia larvae when injected into experimental animals will start sluggish tumors into a rapid growth, which he likens to taking off the brakes from a down-grade trolley (Ztschr. f. Krebsforsch. 1922).

6. An Introduction to Bacterial Diseases of Plants. W. B. Saunders Co., Philadelphia and London, 1920.

The Relative Value of Unfiltered Radium Emanation in Deep Therapy*

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New York City

IN REVIEWING the recent advances of physical therapy, one of the outstanding features has been the effort to determine dosage more accurately. This has undoubtedly been stimulated by the wave of enthusiasm over high-voltage x-rays. While the present methods of standardization by ionization may be open to criticism and subsequent change, they at least furnish a reasonable basis for calculation and comparison of different types of radiant energy.

It is not the purpose of this communication to discuss details of the various methods of applying physical agents. The object is rather to present in as practical a manner as possible the value of interstitial radiation and to compare it, briefly, with the different forms of external radiation.

When we speak of interstitial radiation at the Memorial Hospital, we refer to implantation, within the tissues, of unfiltered tubes of radium emanation. For the purpose of broadening the field to include those using needles containing radium element, the calculations to be shown later have been based on gamma radiation only.

Unfiltered radium emanation tubes, or, as we usually term them, "bare tubes," are fine glass capillary tubes 0.3 by 3 mm. in size, and prepared in such concentration that each tube contains from 0.5 mc. to 2 mc. of emanation. For most types of work about 1 mc. per tube has proved to be the most suitable amount. In some very bulky tumors stronger tubes may be used, and, likewise, in very small lesions or in delicate locations, such as near large blood vessels or nerves, tubes of 0.5 mc. or less are most applicable. These tubes can be readily sterilized by boiling, and Bagg has shown that the emanation is sufficiently bactericidal to sterilize the inside of the tube. This makes their use safe from a surgical viewpoint, even though a tube may be broken within the tissues. These small tubes are placed in the ends of hollow trocar needles, inserted within the tumor to the desired depth and then expelled by pressing in the trocar of the needle. Since radium emanation decreases in value at the rate of approximately 15 per cent per day, it will be seen that the total radiation to be derived from a given tube can be calculated, if its original strength is known. One mc. of radium emanation buried interstitially and left in place gives a total radiation equivalent to 132 mc. hrs. It will also be seen that since the emanation decreases in value at only about 15 per cent per day, a continuous radiation is kept up over a period of many days. The advantages of such a method are at once apparent. It permits of uniform distribution of radiant energy throughout the desired area, whereas external radiation usually delivers its greatest intensity at the least vital part of the tumor—its surface rather than the actively infiltrating base. In addition to accuracy, the intimacy of application has in our experience been one of the chief factors of success in all phases of treatment with physical agents. Unfortunately, we do not know as yet the relative values of beta and gamma radiation, but it is a significant fact that almost invariably our most brilliant results have been those in which beta radiation has played a conspicuous part.

By virtue of the uniformity of distribution possible in interstitial radiation, a smaller total amount of radiant energy is necessary than with external radiation, and less damage is done to skin and adjacent vital structures. The fact that radiation is prolonged over a period of several days permits of greater proportionate dosage.

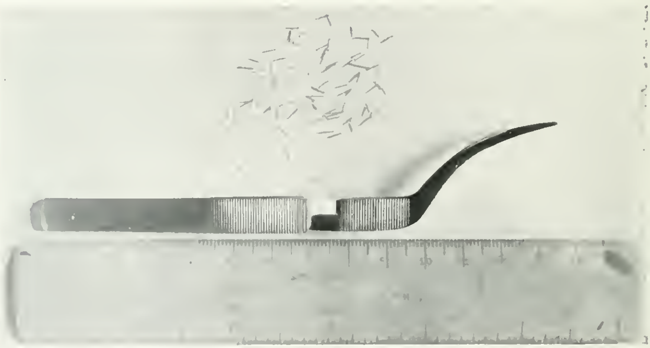

Fig. 1. Unfiltered radium emanation tubes for interstitial implantation.

Fig. 2. Trocar needles for implanting radium emanation tubes.

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 5, 1922.

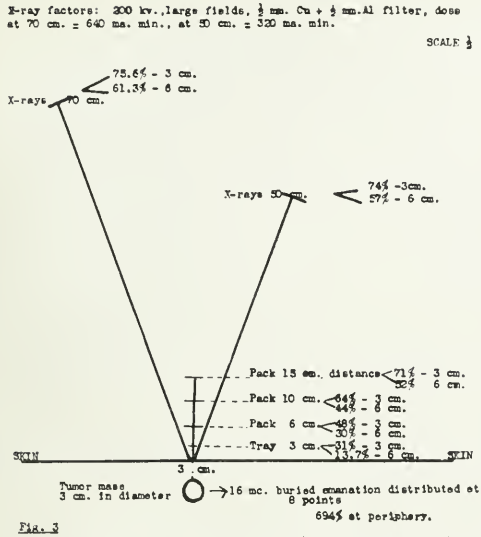

Fig. 3

Fig. 3—Diagram showing relative value of buried radium emanation, filtered radium externally, and high voltage x-rays. Percentages are in terms of erythema dose at skin surface taken as 100. Unfiltered radium emanation doses calculated for γ-rays only. **Radium factors:** filter, 2 mm. brass throughout; pack dose at 15 cm. = 42,000 mc. hrs; at 10 cm. = 20,000 mc. hrs; at 6 cm. = 10,000 mc. hrs. Tray dose at 3 cm. = 2200 mc. hrs.

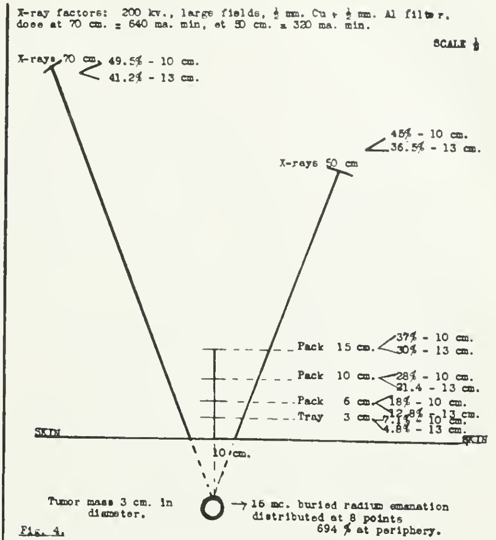

Fig. 4.

Fig. 4—Diagram showing relative value of buried radium emanation, filtered radium externally, and high voltage x-rays. Percentages are in terms of erythema dose at skin surface taken as 100. Unfiltered radium emanation doses calculated for γ-rays only. **Radium factors:** filter, 2 mm. brass throughout; pack dose at 15 cm. = 42,000 mc. hrs; at 10 cm. = 20,000 mc. hrs; at 6 cm. = 10,000 mc. hrs. Tray dose at 3 cm. = 2200 mc. hrs.

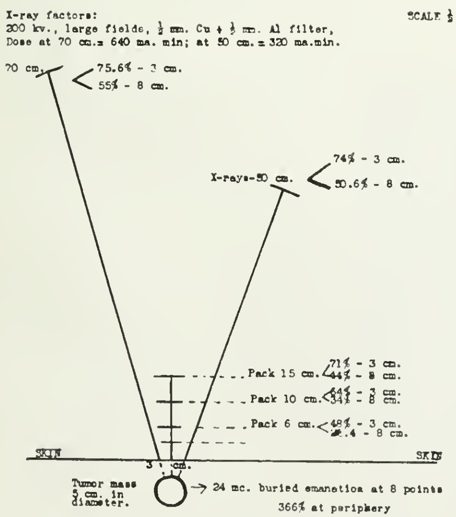

Fig. 5.

Fig. 5—Diagram showing relative value of buried radium emanation, filtered radium externally, and high voltage x-rays. Percentages are in terms of erythema dose at skin surface taken as 100. Unfiltered radium emanation doses calculated for γ-rays only. **Radium factors:** filter, 2 mm. brass throughout; pack dose at 15 cm. = 42,000 mc. hrs; at 10 cm. = 20,000 mc. hrs; at 6 cm. = 10,000 mc. hrs. Tray dose at 3 cm. = 2200 mc. hrs.

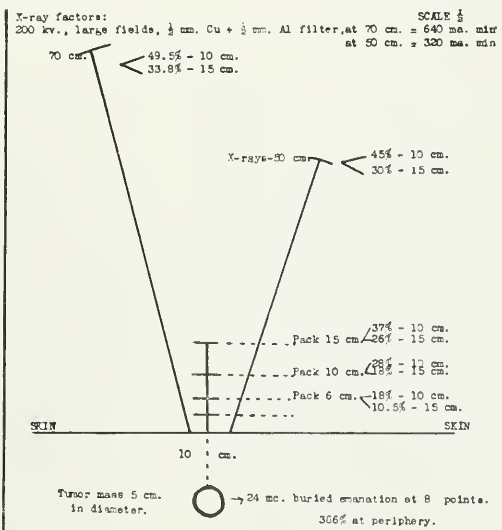

Fig. 6.

Fig. 6—Diagram showing relative value of buried radium emanation, filtered radium externally, and high voltage x-rays. Percentages are in terms of erythema dose at skin surface taken as 100. Unfiltered radium emanation doses calculated for γ-rays only. **Radium factors:** filter, 2 mm. brass throughout; pack dose at 15 cm. = 42,000 mc. hrs; at 10 cm. = 20,000 mc. hrs; at 6 cm. = 10,000 mc. hrs. Tray dose at 3 cm. = 2200 mc. hrs.

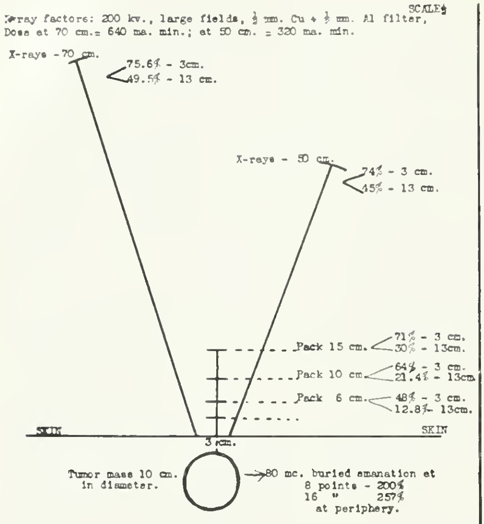

Fig. 7.

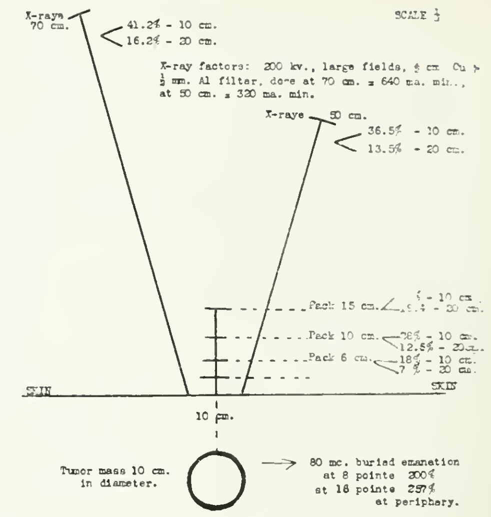

Fig. 8.

Fig. 7—Diagram showing relative value of buried radium emanation, filtered radium externally, and high voltage x-rays. Percentages are in terms of erythema dose at skin surface taken as 100. Unfiltered radium emanation doses calculated for γ-rays only. **Radium factors:** filter, 2 mm. brass throughout; pack dose at 15 cm. = 42,000 mc. hrs; at 10 cm. = 20,000 mc. hrs; at 6 cm. = 10,000 mc hrs. Tray dose at 3 cm. = 2200 mc hrs.

Fig. 8—Diagram showing relative value of buried radium emanation, filtered radium externally, and high voltage x-rays. Percentages are in terms of erythema dose at skin surface taken as 100. Unfiltered radium emanation doses calculated for γ-rays only. **Radium factors:** filter, 2 mm. brass throughout; pack dose at 15 cm. = 42,000 mc. hrs; at 10 cm. = 20,000 mc. hrs; at 6 cm. = 10,000 mc. hrs. Tray dose at 3 cm. = 2200 mc. hrs.

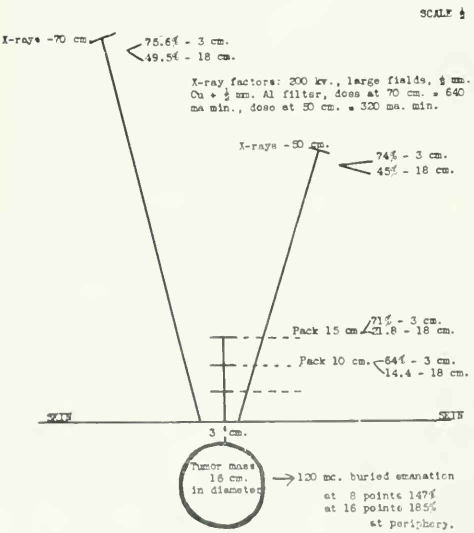

Fig. 9.

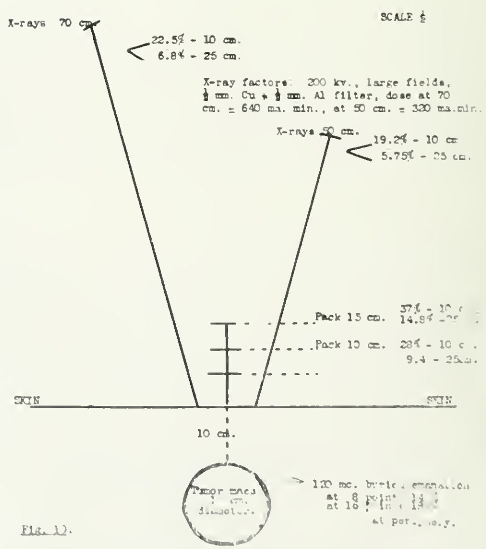

Fig. 10.

Fig. 9—Diagram showing relative value of buried radium emanation, filtered radium externally, and high voltage x-rays. Percentages are in terms of erythema dose at skin surface taken as 100. Unfiltered radium emanation doses calculated for γ-rays only. **Radium factors:** filter, 2 mm. brass throughout, pack dose at 15 cm. = 42,000 mc hrs, at 10 cm. = 20,000 mc. hrs, at 6 cm. = 10,000 mc hrs. Tray dose at 3 cm. = 2200 mc hrs.

Fig. 10—Diagram showing relative value of buried radium emanation, filtered radium externally, and high voltage x-rays. Percentages are in terms of erythema dose at skin surface taken as 100. Unfiltered radium emanation doses calculated for γ-rays only. **Radium factors:** filter, 2 mm. brass throughout, pack dose at 15 cm. = 42,000 mc. hrs, at 10 cm. = 20,000 mc. hrs; at 6 cm. = 10,000 mc. hrs. Tray dose at 3 cm. = 2200 mc. hrs.

As a rule, an effort is made in using this method to accomplish a complete regression by a single dose. The advantages are two-fold. The bulk of the tumor is influenced by the radiation before the formation of new connective tissue has reached such proportions as to protect neoplastic cells. The procedure is less trying for the patient, and, while the local effect is more intense, the constitutional reactions are much less marked.

The flexibility of the method offers many interesting possibilities. The tubes may be buried in locations where surface applications cannot be retained accurately in place. The combinations with surgery are many. A tumor may be given an overdose of radiation with bare tubes and then be removed surgically at a later date when it is a much safer operative risk. This obtains with many bulky extensively ulcerated lesions where a prompt relief from absorption is essential to the patient's general health. Bare tubes may be inserted at any suspicious point in the base of a surgical field and the wound closed without endangering its healing. We make extensive use of this plan in our neck surgery. Many tumors considered operable are found at the time of exposure to be inoperable—bare tubes may here be utilized to advantage before the wound is closed. If there is any doubt as to the accuracy of placing the tubes, surgical exposure should be employed. The possibilities of this combination of surgery and bare tubes in dealing with intra-abdominal new growths are too numerous to mention.

The method, of course, has limitations. It is essentially one for use in dealing with localized growths. Danger from the glass tubes as foreign bodies is practically negligible. The intense local effect excites an inflammatory reaction which results ultimately in the encapsulation of the tube by fibrous tissue. There is danger of spreading infection deeper into the tissues if the tubes are introduced through foul ulcerating surfaces—under such circumstances care should be taken to introduce them through surrounding healthy tissues and directed toward the tumor base. The dangers of damage to nerves and blood vessels and of creating too much local caustic effect are not serious and are matters readily avoided by experience.

For the purpose of comparing, from a physical standpoint, the efficiency of bare tubes, within their field, with methods of external radiation, I have constructed a number of practical diagrams, giving in each instance the doses commonly used. The doses given for x-rays and external radium applications are those found by both experience and physical calculation to be the most efficient for the given distances. The doses given for bare tubes are those which we have found to be safe and practical in our every day work. In the case of the larger tumors, especially, the doses given are decidedly minimum.

I am indebted to *Dr. Gioacchino Failla*, the director of our physical

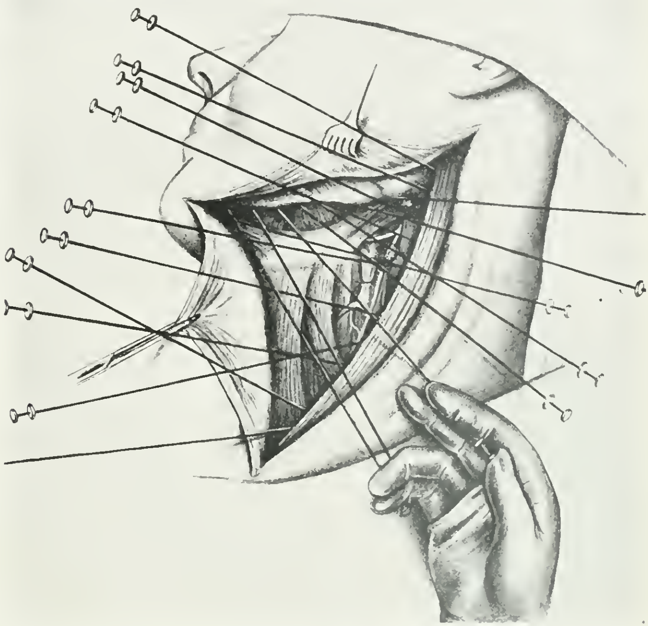

Fig. 11—Drawings to show method of implanting radium in neck as final stage of a surgical dissection.

Fig. 12—Osteogenic sarcoma of radius.

Fig. 13—Same tumor as shown in Fig. 12. Twenty-two months after implantation of radium emanation. Note contraction and deposit of new bone.

laboratories, for all of the percentages and calculations used in these comparisons.

A study of the diagrams will readily show the superiority of interstitial radiation. The figures given for bare tubes consider only gamma radiation and do not take in the tremendous local effects of beta rays. The number of point sources are far below those used in actual practice and hence indicate a lower dosage than is actually the case. In making the comparison with external radiation we must remember that these doses may be directed from two, three or four angles at the tumor. Even at that, the interstitial dose of *gamma rays alone* is superior to the multiple external cross-fire. The most marked advantage of interstitial over external radiation, of course, is in the smaller mass at greater depth.

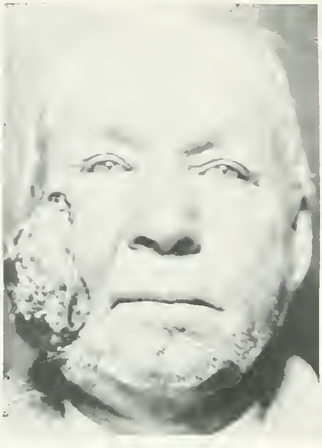

Fig. 14—Squamous carcinoma of cheek.

Fig. 15—Same case as Fig. 14. One year after implantation of radium emanation plus external filtered radium.

Fig. 16—Angioma of tongue

Fig 17 Same case of Fig. 16. One year after buried radium emanation.

Fig. 18—Microphotograph to show lymphocytic infiltration round about an area treated by buried radium emanation.

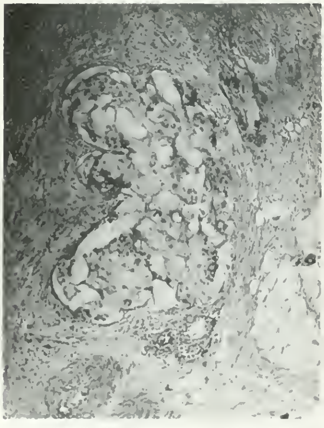

Fig 19 Microphotograph of adeno-carcinoma of rectum Note lymphocytic infiltration and formation of new connective tissue.

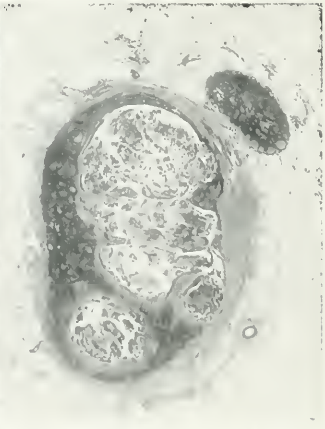

Fig. 20- Metastatic cervical node, squamous carcinoma Six weeks after treatment by buried radium emanation Note complete destruction of neoplastic tissue.

From a biological standpoint we now have ample evidence to indicate that the physical agents intensify the natural reaction of the tissues to new growth. In addition to the powerful destructive effect on tumor tissue itself, radiation tends to increase the exudation of lymphocytes and plasma cells and the growth of connective tissue around the tumor.

From a practical standpoint, as indicated by the accompanying microphotographs and six and a half years clinical experience with bare tubes, we are convinced that interstitial radiation intensifies these natural reactions to a far greater extent, with less damage to the patient, than does external radiation.

We are further convinced that bare tubes, both by reason of their flexibility in range of application and the added advantage of beta radiation, are superior to metal needles containing radium element for interstitial use.

The Routine X-Ray Examination of the Nasal Sinuses by Four Projections*

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Chicago

THE USUAL technique in x-ray examination of the nasal sinuses consists of two exposures, one of which is a postero-anterior projection and the other is a lateral view. Inquiry among a large number of roentgenologists discloses this two projection method to be the rule. The anatomical situations of the several nasal sinuses are such that these two particular projections do not give the maximum diagnostic shadow value as to the pathological or non-pathological condition of all the four sinuses. With the usual postero-anterior, 23° projection, the shadows are of greatest value for the frontal sinuses but are of least value as to the sphenoid cells, with the ethmoid and maxillary sinuses falling, respectively, second and third in order. Notwithstanding this established fact, many specialists on nasal sinus diseases refer patients to the roentgenologist with a request for "one, postero-anterior view only." Many of them seem to be of the opinion that this view only is necessary in the detection of sinus pathology and that other projections are of no value and therefore superfluous and they feel that they are saving the patient some of the usual fee because of the single exposure. The writer's experience teaches that this idea is incorrect. It seems to be the result of noting that the standard 23° projection really gives no satisfactory or reliable information other than an index to the condition of the frontal and ethmoid cells and occasionally the maxillary sinuses. This single exposure examination of the sinuses should be condemned as incomplete work and the roentgenologist who is satisfied with such a technique is remiss in his duty to himself, the patient and the referring specialist.

To those who use the 23° postero-anterior and the straight lateral projections it can be said that the greatest amount of information in these cases is obtained by adding two more exposures to those just enumerated. These are (a) the maxillary and (b) the sphenoid projections, the routine use of all four of which is advised. Specific reasons for the employment of each of these follows with their value over the usual two film exposure technique.

From a practical standpoint the twenty-three degree position of sinus study should be used mainly for the frontal and ethmoid cells because the maxillary sinuses are, in this projection, over-shadowed by the heavier portions of the temporal bones as well as those of the base of skull, while the sphenoid cells fall into the upper nasal areas, being easily confused therewith. It is not often that the cells, walls and intercellular septum of the sphenoids can be identified on this particular exposure.

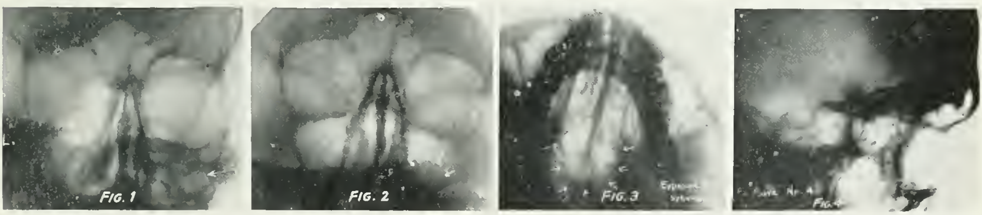
To enhance the diagnostic value of x-ray studies of the nasal sinuses the following four projections are recommended: the 23°, postero-anterior; the maxillary, postero-anterior; the sphenoid, superior-inferior; the lateral.

None of these four projections is a new one and all have received extended attention in x-ray literature for a long time, but the routine use of all of them is seldom found to be the practice, the first and fourth being the rule in most laboratories. There are a few roentgenologists who do use routinely three of these positions and a still smaller number whom I have found using all four projections.

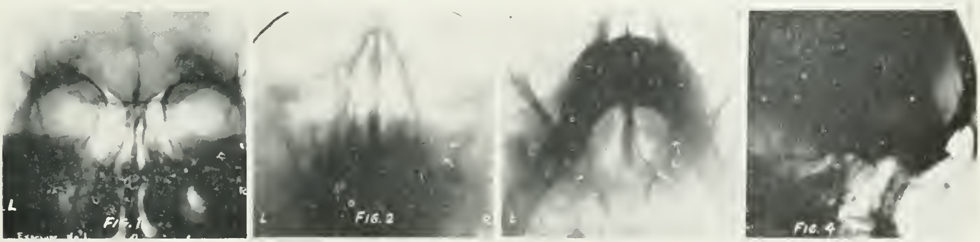
First Projection

The value of the twenty-three degree projection is known to all acquainted with this work and needs no extended elaboration in this presentation. The film holder or cassette is placed so that its upper edge is lifted away from the surface of the table,

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 6, 1922.



Case I.—**Fig. 1**—Frontal-ethmoid: (23°) projection, postero-anterior; frontal asymmetrical, both clear; ethmoids, left clear, right diseased (note unsatisfactory shadows of antra). **Fig 2**—Maxillary projection: postero-anterior (Water's position). Left clear, right has rounded tumor, probably polyp or mucocele (not visualized on 23° projection). Frontal shadows confirmed. **Fig. 3**—Vertical sphenoid projection: superior-inferior, showing clear sphenoid cells, fairly symmetrical outline and extent (not seen on 23° projection). **Fig. 4**—Lateral projection revealing topography of all sinuses, particularly the frontal and sphenoid areas.



Case II.—**Fig. 1**—Frontal-ethmoid: postero-anterior projection, large frontals irregular configuration, right cell faintly clouded; ethmoids, right-side cells are slightly less transparent than left; the side is clear. **Fig. 2**—Maxillary: postero-anterior projection, left antrum lacks transparency in lower two-thirds, probably thickened membrane; right antrum contains rounded shadow lying against nasal wall, probably a muscle (not demonstrated on exposure No. 1). **Fig. 3**—Sphenoid: superior-inferior projection, asymmetry of cells, very large left, small right, clouding on left. **Fig. 4**—Lateral projection: deep frontal, shallow sphenoid.

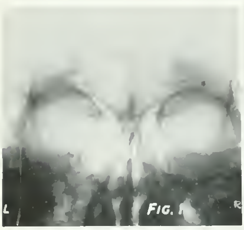
resting on a support which is approximately 23° with horizontal; the patient lies prone with the forehead against the film holder and with the nose flattened against its surface; the x-ray tube is directed vertically downward with central axis of x-ray emerging at the glabella. The resulting shadows are the very best possible of the frontal and ethmoid cells. This projection should be used in determining the condition of the frontal and ethmoid sinuses only. The frontal sinuses are studied to determine the topography, symmetry, extent on each side of the median line, extent upwards into the frontal bone, size of the horizontal recess, presence or absence of bilateral or unilateral double cell formation, complete or incomplete septa, absence of frontal cells on one or both sides, transparency, translucency or opacity of one cell as compared with the other, and other variants from the normal. The shadows of the ethmoid cells are noted to determine their extent, transparency, translucency or opacity to the x-ray. They lie below the frontal sinuses and between the outer nasal and inner orbital walls, and are above the maxillary sinus shadows, sometimes overlapping these boundaries. They are normally quite transparent to the x-ray. When in normal condition both ethmoid groups are of an equal degree of clear shadow. The presence of pus or other products of inflammation reduces the transparency in proportion to the amount of increase of such products.

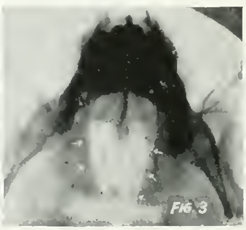
Second Projection

The maxillary projection, often referred to as the "Waters position," is of greatest value in determining the condition of the antra. The film holder or casette lies in horizontal position, preferably four and one-half inches above the table surface, the patient lies prone with tip of chin resting on the film holder and tip of nose barely in contact with its surface; the central axis of x-ray is directed so that it passes vertically downward through the skull, emerging at the tip of the nose. This position results in tilting the head backward which causes the temporal bone shadows to fall below the lowest margin of the maxillary sinuses. Thus, both normal antra are seen as clear uncovered triangular areas with rounded corners lying on both sides of the nasal passages. With this projection a far greater positiveness is obtained in reading the shadows than is possible with the first projection. The frontal sinuses are seen to be larger than they are seen on the first exposure, due to their greater distance from the film, but a check up on the shadow densities of 23° exposure is easily made. The ethmoid sinuses are blocked out by the shadows of the nasal bones. In determining the presence or absence of pathological change in the maxillary sinuses one finds it possible to discover on this exposure very slight shadow variations and often lesions not detected on the 23° projection. Then, too, doubtful transluciences on the 23° plate are identified as a positive or negative finding, as the case may be. It is the one means of demonstrating polyps and similar tumors in the antrum. (In cases where a diffuse even density of marked degree is found it is advisable to make a supplementary exposure with patient's head in upright position, directing the x-ray horizontally through the back of head. This will reveal whether a fluid level is present, thus distinguishing between a greatly thickened membrane lining the antrum, or other non-fluid condition, from pus or other free fluid in the antrum).

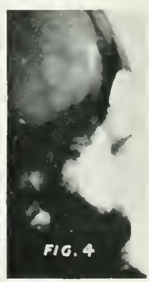
Third Projection

The sphenoid cells lie on both sides of the median line in the body of the sphenoid bone which is practically in the center of the base of the skull. They are usually separated by a thin bony wall or septum. Occasionally these cells can be identified on the twenty-three degree postero-anterior projection, but this occurs so seldom that this exposure cannot be depended upon when there is a question of disease. Several methods of examination of the sphenoid cells have been proposed and used by various roentgenologists, some projecting the cells into the orbits (Pfahler), some using other technique, but the most practical one is the superior-inferior projection as advised by Law. The plate is placed in horizontal position, preferably about four and one-half inches higher than the table on which the patient lies prone. The chin is extended to its maximum and the inferior





Case III.—**Fig. 1** Frontal-ethmoid, postero-anterior projection, frontals large size, cloudy right, clear left; ethmoids, less clear right, normal left **Fig. 2** Maxillary: postero-anterior projection, left antrum is clear, right antrum cloudy. **Fig. 3**—Sphenoid, superior-inferior projection, both cells large (occupying all of body of sphenoid), symmetrical and clear. (Also confirmation of right antrum pathology.) **Fig. 4**—Lateral projection: frontals not very deep, large sphenoids.



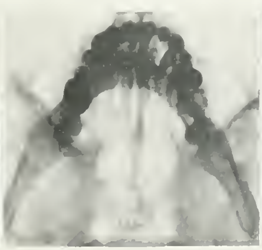
Case IV. **Fig. 1** Frontal-ethmoid postero-anterior, a projection, frontal cells medium size, fairly symmetrical, both of normal transparency. The intercellular bony septum is markedly widened (nonpathological) in lower portion encroaching on both cells. Ethmoids on left are considerably less transparent than normal, on right are clear. **Fig. 2** Maxillary postero-anterior projection, both cells distinctly clouded in lower portions, suggesting marked thickening of mucous membrane lining the floor and extending upwards on walls as from old chronic inflammation. **Fig. 3**—Sphenoid, superior-inferior projection, left cell smaller than right, both clear. **Fig. 4**—Lateral projection frontals of normal depth, sphenoids (cut off on illustration) are large.

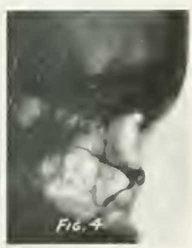
margins of the jaws lie parallel and directly in contact with the surface of the film holder. The near edge of the film holder or casette rests against the episternal notch, care being used that the patient's breathing be not interferred with by pressure on the trachea, which in this position is forced against the edges of the cassette. The central axis of the x-ray beam is directed vertically downward through the vertex of the head to emerge at a point which is on a line with the angles of the lower jaw. This projection throws both sphenoid cells into the center of the film and the sphenoid area is found just posterior to (often overlapping) the posterior nares. The shadow outlines of both sinuses can usually be readily identified lying immediately in front of the less dense shadow of the pharynx. A patient of short stature and individuals with a short neck cannot extend the head sufficiently to obtain the required position; in this event the x-ray tube is moved towards the top of the table and is tilted backwards at such an angle as will permit the central axis of the x-ray beam to pass through the vertex of the skull, through a point midway between the external angular process of the orbit and the canal of the ear, and emerging at the angle of the jaw. The shadows of the sphenoid sinuses reveal the size, shape, symmetry and condition as to transparency, translucency or opacity to the passage of the x-rays. On this projection it is surprising to find the frequently different sizes of right and left sinuses, and in a few instances the writer has found a single cell instead of the usual bilateral cavities, no dividing septum being present. In two cases a total absence of sphenoid sinuses, diagnosed clinically as being infected, has been determined by this method. Obviously, a cloudy or opaque cell on one side will present a marked contrast to an opposite one if it is of a normal transparency. On this projection the anterior and posterior clinoid processes may be visualized and the hyoid bone, which is of more or less horseshoe shape, is also seen. In addition one observes the anterior arch of the atlas (first cervical vertebra) and the odontoid process of the axis (second cervical vertebra) at the lower edge of the film. The temporo-mandibular articulations, rami and body of the mandible are seen in this direct superior-inferior view. In some cases large inferior turbinate bones will overlie the anterior portions of the sphenoid cells and one must, of course, discount such shadows and not mistake them for evidence of sinus disease. On this projection, too, it often happens that a check up on the radiability of the frontal and maxillary cells can be made to further substantiate variations in transparency found on the first two projections, thus adding to its value.

Fourth Projection

The lateral projection is of prime importance in determining the topography of the several sinuses. It seldom reveals pathological change, owing to the fact that both right and left sinuses of each of the four groups are projected upon each other. This is one reason why some men do not want a lateral projection. It is, however, a very necessary view, giving, as it does, information not obtainable in any other way. It is of utmost importance that a true lateral view be obtained. This is accomplished by placing the patient so that he lies squarely on his right or left side, the film horizontal and about four and one-half inches above the level of the table top. The head must be in exact normal alignment with the long axis of the spine, and a vertical line must cut the centers of pupils of both eyes. The tip of the nose and the external occupital protuberance must be equidistant from the surface of the film holder. The central axis of the x-ray is directed vertically downward, centered on the external angular process. This view is of utmost value in certain cases in which an absence of frontal cells is to be differentiated from pus filled sinuses. If the frontal bone fails to divide into an anterior and a posterior wall thus forming a cavity in the frontal bone, the indication is that a congenital absence of frontal sinuses exists. If such a separation is seen, then an opaque area between the two walls indicates sinus infection or other pathological condition. The antero-posterior depth of the frontal sinus is determined on this view and this is an index as to the degree of transparency that the frontal sinuses should show on the 23° postero-

Case V.—**Fig. 1**—Frontal-ethmoid, postero-anterior projection, frontals are very large, symmetrical in outline but assymetrical in configuration, there being almost complete septa in the left which seemingly divide this cell into separate chambers, while there are no such bony divisions in right; both are clear. Ethmoids on left are markedly clouded, while the right side is clear. (Maxillary cells are seemingly clouded.) **Fig. 2**—Maxillary postero-anterior projection, both cells are clear (This definitely rules out the doubtful evidence on 23° projection. **Fig. 3** Sphenoid:superior-inferior projection, left cell is larger than right, both clear. **Fig. 4**—Lateral projection: very deep frontals (illustration cuts off the sphenoids but original exposure shows these to be large). Posterior ethmoid area definitely clouded





Case VI. **Fig. 1** Frontal-ethmoid: postero-anterior 23° projection, total absence of frontal cells, ethmoids clear on both sides. (Left antrum appears less clear than right). **Fig. 2**—Maxillary: postero-anterior, both antra are clear, ruling out the doubtful evidence of left side pathology seen on Figure 1. **Fig. 3** Sphenoid. superior-inferior projection, both cells medium size; both normal transparency. **Fig. 4**—Lateral projection: shows failure of tables of skull to divide, thus establishing a congenital absence of frontal sinuses, sphenoid area clear (illustration cuts off posterior portions).

anterior plate. On this lateral view one learns of the extent of the horizontal recesses of the frontal sinuses which occasionally are found to extend far posteriorly under the floor of the anterior fossa of the cranial cavity. In some cases this horizontal portion may be the entire extent of the frontal sinus, the vertical portion being absent.

On this lateral view the ethmoid cells are seen to lie posterior to the frontal cavity. The individual cells may be of large or of small size, but are most often of various sizes. Some writers divide these cells into anterior, middle and posterior groups, while other anatomists speak of an anterior and posterior group. Roughly, one can identify these divisions on this projection. Occasionally one is able to see pathological involvement of the anterior group while the posterior group is clear, or vice versa. (Obviously, one cannot distinguish between right and left side involvement on this exposure regardless of which side of the head is placed against the film, but the first projection gives this particular information). Often the foremost of the anterior ethmoid cells will overlap, and sometimes be confused with the frontal cells. They may be seen to also overlap the sphenoid area.

The shadow of the maxillary sinus usually is seen as a large, more or less quadrilateral area of considerable transparency which most often is seen to be quite clear even when there is pathology in one of the antra as seen on the maxillary projections. If both are diseased one usually finds a translucency, although occasionally it has been found to be fairly transparent in spite of the presence of the double infection.

The sphenoid sinus on this lateral projection is seen to lie directly under the sella turcica, and, in the normal condition, is relatively quite transparent to the x-rays. The size of the cells is observed and checked up with that seen on the third, the sphenoid projection. Sometimes these cells are very small or may even be totally absent, as has already been referred to. Variations in extent are often found and there are instances in which they are seen to literally dissect the dorsum sella from below, even entering the posterior clinoid processes. Thus, the normally thin plate of bone is separated into an anterior and posterior wall, a superior recess of the sphenoid sinus lying between them. Some sphenoid cells are seen on this lateral projection to lie entirely in the anterior half of the body of the bone, the shadows of the posterior half being made up of cancellous bone tissue.

In using these four projections the total exposure time must be kept at a minimum by using double screens and a one or two millimeter filter. A satisfactory result is obtained by an exposure of three, four, five and one seconds respectively for the four projections described, using 20 ma. at 5 inch gap. In several hundred cases not a single instance of epilation or other untoward effect has occurred with this technique.

Summary

1. A single exposure of the nasal sinuses is meager evidence on which to base an opinion as to the presence or absence of sinus disease and tends toward errors in interpretation.

2. The two exposure technique, consisting of a frontal and a lateral projection, gives satisfactory evidence as to the frontal and ethmoid sinuses, but the condition of the maxillary and sphenoid cells is not so well determined and therefore should be regarded as an incomplete examination.

3. The four projections, as here set forth, give the maximum information and therefore should be used in the routine examination of the nasal sinuses.

X-Rays and X-Ray Apparatus; An Elementary Course*

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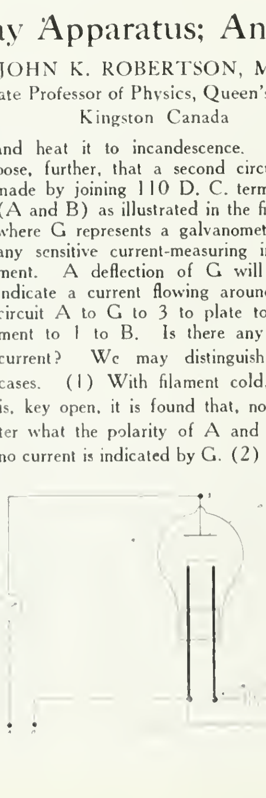
THE COOLIDGE TUBE

Thermionic Emission of Electrons

63. It has already been noted that in a Coolidge tube the vacuum is nearly as perfect as modern means of exhaustion can make it. So high is the vacuum that if an attempt is made to use it as a gas tube, no current passes even with 150,000 volts across the tube. How, then, does it operate? To answer that question, it is necessary first of all to explain what is meant by a thermionic emission of electrons. This can best be done with reference to one or two simple experiments. In Figure 58, B represents a highly exhausted glass bulb provided with three electrodes, 3 joined to an inner sheet of metal P; 1 and 2 to the ends of a filament F of fine wire, tungsten for example. Suppose, now, that 1 and 2 are connected to a storage battery by means of which current may flow through the filament and heat it to incandescence. Suppose, further, that a second circuit is made by joining 110 D. C. terminals (A and B) as illustrated in the figure, where G represents a galvanometer or any sensitive current-measuring instrument. A deflection of G will then indicate a current flowing around the circuit A to G to 3 to plate to filament to 1 to B. Is there any such current? We may distinguish two cases. (1) With filament cold, that is, key open, it is found that, no matter what the polarity of A and B is, no current is indicated by G. (2) With the filament incandescent (key closed), however, if B is negative, marked current is indicated, whereas if B is positive, no current passes. Evidently, therefore, a current passes through such a tube when the filament is hot and when it is negative. Now, what is the explanation? It is found in the fact that any hot piece of metal is a source of electrons. At the surface of metals a process somewhat akin to evaporation goes on, as a result of which, at high temperatures, there is a copious emission of electrons known as *thermionic emission*. In the above tube, therefore, the hot filament liberates electrons; if the filament is negative, and the plate positive, since negative repels and positive attracts negative electricity, these electrons are driven across the vacuum space. There is, therefore, a current of electricity which, in this case, consists of a stream of negatively charged electrons. If the filament is positive, however, because of the attraction of positive for negative, the electrons cannot escape from the filament and no such current exists.



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Hot Filament Rectifiers—The Kenotron

64. It should now be evident that if 110 volts *alternating* is applied to AB, a stream of electrons will cross the tube only during the half cycle when the filament is negative. In other words, an intermittent but uni-directional current flows in the circuit containing G, although an alternating voltage is applied. Such a three-electrode tube, therefore, is an excellent rectifier and has many practical applications. The use of such a valve tube in "Radio" will be familiar to many readers, while we have already made reference (Sec. 38) to such a means of suppressing inverse current. The same principle is utilized in the *Kenotron*, a device perfected by Dr. S. Dushmann of the General Electric Research Laboratory, for the rectification of a high tension voltage. How perfect is the rectification, is well shown in Fig. 59, where the upper curve shows the variation in the alternating voltage applied to a kenotron, while the perfect uni-directional, although intermittent, current is clearly shown in the lower curve. For the loan of the original electrotype of this figure, as well as those of Figures 64, 65, 66, 71, 72, 73 my grateful thanks are due Dr. W. D. Coolidge, of the General Electric Company.

65. Now the Coolidge x-ray tube, for which we have to thank the genius of Dr. W. D. Coolidge, is a direct application of the principle of thermionic emission. It differs from the gas tube, not because x-rays originate for any different reason but because the stream of high speed electrons has its origin in an incandescent filament of metal. To heat the filament, an independent circuit, called the *filament circuit*, is necessary. In the original arrangement (Fig. 60), a storage battery B_1 and B_2 was used as the source of supply for this circuit. In the arrangement now on the market (Fig. 61), a branch from the A. C. mains supplies a small filament transformer, the secondary of which is connected in series with the filament. While this arrangement is more convenient, it has one disadvantage. Voltage fluctuation on the line will cause corresponding fluctuations in the filament and consequently, as we shall see later, alter the milliamperage through the tube.

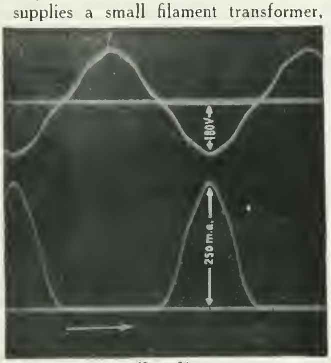
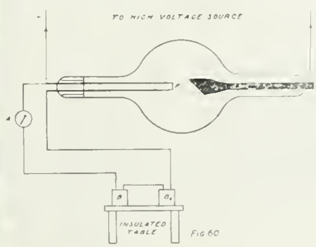


Fig. 59

To give the necessary high speed to the liberated electrons, the high tension voltage is applied to the tube in the usual way, the hot filament being, of course, negative. Since the whole filament circuit is raised to the high potential of the cathode, it is necessary to insulate the storage battery (or the filament transformer). The complete circuit for the ordinary Coolidge tube, therefore, includes (1) the usual high tension circuit, (2) the filament circuit. In Figure 62 connections for the complete arrangement (minus the synchronous motor circuit) are shown. It will be seen that the high tension circuit, which in this case has the auto-transformer control, is exactly the same as that already discussed. The new feature is the filament circuit controlled by the filament switch and containing an ammeter to enable an operator to read the current heating the filament. By means of a variable inductance (I) the strength of the current may be altered. Before discussing details of control, however, it is desirable next to look at some further points in connection with the tube itself. There are some half dozen types of tube now on the market but in the meantime our remarks shall refer primarily to the standard so-called "Universal" type.

The Universal Standard Tube

66. To obtain the necessary high degree of exhaustion, and to eliminate as much as possible all traces of residual gas, elaborate precautions are taken. "All metal parts before being mounted are fired in a quartz tube vacuum furnace at 900 C. for about an hour, and are allowed to cool down in a vacuum so as to prevent oxidation. The purpose of this firing is to render the parts perfectly clean and to remove partially the occluded gases".[1] During exhaustion the tube itself is heated in an oven at about 400 C. for three quarters of an hour. After this process the tube is operated at higher and higher voltages until "all signs of gas have disappeared and the tube is backing up a 10 inch parallel spark gap and the anode is at an intense white heat".[1] Here it may be noted that the presence of harmful amounts of gas is indicated by the appearance of a greenish glow in the bulb. Should a tube which has been in use develop such an appearance, it is an indication of impaired vacuum and re-exhaustion will probably be necessary.



Focusing

67. The hot filament, consisting of a piece of fine tungsten wire (0.0085" in diameter) wrapped into a small spiral, is surrounded by a concentric cylinder of molybdenum (C, Fig. 63), the inner end of which projects a little beyond the filament. At the other end of the cylinder, a plane flange of molybdenum is placed. As the cylinder and flange, as well as the filament, are in electrical contact with the high tension terminal, a repulsive action is exerted on the liberated stream of electrons and focusing results. By using filaments of different shapes and adjusting the relative positions of the parts, focal spots of different sizes are obtained. In actual practice, tubes with fine, medium and broad focal spots are constructed.

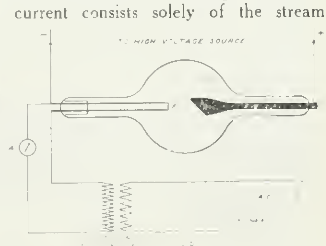
The general principle of the focusing device will be clear from Figure 63. Figure 64 shows a close-up view of the cathode of the radiator type tube (Sec. 73), in which case the flange is replaced by a hemispherical cup.

The Anode

68. In the universal tube this consists of a solid rod of wrought tungsten attached to a stem of molybdenum. Figure 65 renders any detailed description unnecessary. As the anode is also the anticathode, the tube has the simple appearance shown Fig. 66.

Control of Tube Current

69. In the gas tube we have seen that the residual gas is conducting, the current consisting of a stream of positive ions in one direction, along with cathode rays in the opposite direction. In the Coolidge tube the current consists solely of the stream



of negative electrons liberated from the hot filament. How is the magnitude of this current controlled? In seeking to understand the answer to that question, it is well to recall that an electric current is measured by the total quantity of electricity passing each second any "point" on the circuit. If, therefore, more electrons are transferred every second from the filament to the target, the tube current will be greater. Now work on thermionic emission has shown that the higher the temperature of the hot filament, the greater the supply of electrons. *The milliamperage through a tube, therefore, is increased simply by increasing the filament heating current.* But it is asked, where does voltage come in? That can be answered with reference to experimental results such as given in Tables VI and VII (taken from Wappler Electric Co. literature). The numbers in Table VI refer to a Coolidge tube, for which the filament current is kept constant at 4.10 amperes.

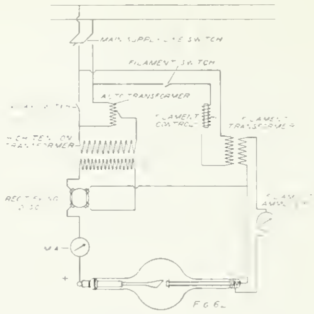
TABLE VI

Filament Current 4.10 amp.	
Back-up	Ma.
1"	13
1"	15
1¾"	18
2½"	20
3½"	21
4¼"	21
5¼"	21

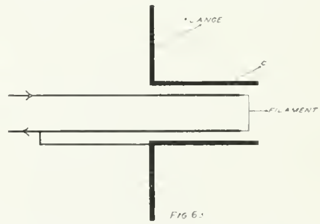
TABLE VII

Filament Current 4.20 amp.	
Back-up	Ma.
1"	16
1"	18
1"	20
1¾"	22
2¾"	25
3¼"	25
4¼"	26
5"	26

By means of the rheostat (or autotransformer) control, greater and greater voltages are applied to the tube, and for each value, the corresponding tube current measured. It will be noticed that, while at first the tube current increases with increasing voltage, a stage is reached at which increase in voltage produces no increase in milliamperage. Those who prefer to study results in graphs rather



than in tables will see that curve A, Figure 67 shows the same result even more clearly. In Table VII and Curve B, Figure 67, the same result is shown for a different filament current, the only difference in the two cases being that the maximum tube current in the latter is greater. Experiment tells us, then, that *corresponding to each filament current, there is a maximum value of the tube current, which is independent of the applied voltage.* The explanation of this maximum current—called *saturation current*—is simple enough. The available supply of electrons from a hot filament depends on its temperature and therefore on the magnitude of the filament current. Evidently no more



electrons can be transported across the tube per second than are liberated each second from the filament. At first, when higher and higher voltages are applied to the tube a greater and greater number of electrons is transported each second across the tube. Ultimately, however, a stage is reached at which as many electrons reach the anode per second as are liberated from the filament. Evidently further increase of voltage cannot increase this number (although it will increase their speed), or once more, the saturation current has been reached. In actual practice, the back-up of a tube is invariably great enough to ensure the existence of saturation currents for all filament current values used.

Control of the Coolidge tube *current*, therefore, depends for all practical purposes, solely on regulation of the filament current whose magnitude is read directly from the filament ammeter. It is, then, highly desirable that the operater of a particular Coolidge tube should know the tube (saturation) current corresponding to each ammeter reading. Such a relation he can readily obtain for himself by taking, for each of several filament current values, a series of tube current values and corresponding back-ups (as in Tables VI and VII) until the saturation stage has been reached. If, then, for each filament current, he records the saturation tube current, he will have a table similar to Table VIII, (a copy of some actual results taken from an early paper by Dr. W. D. Coolidge). By plotting these results, an extremely useful curve similar to that in Figure 68 will be obtained. Figure 69 is a copy of a

TABLE VIII

Filament Current	Tube Current
3.09 amp.	0.6 ma.
3.31 amp.	2.5 ma.
3.40 amp.	4.4 ma.
3.50 amp.	8.2 ma.
3.57 amp.	12.6 ma.
3.67 amp.	20.7 ma.
3.65 amp.	21.8 ma.
3.71 amp.	27.0 ma.
4.13 amp.	35.4 ma.

similar curve for a universal tube taken from recent literature of the Victor Electric Corporation.

In the universal Coolidge tube, therefore, the tube current is controlled by the filament and, if saturation current is used (as is nearly always the case), is independent of the voltage across the tube. (Increasing the back-up does not increase the tube current, but does alter, as we shall see later, the nature of the beam of x-rays leaving the tube). Regulation of milliamperage and of voltage, accordingly, may be made with much greater readiness and exactness than is the case with a gas tube.

The Voltage Stabilizer

70. In connection with the relation

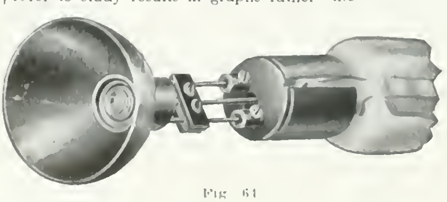


Fig. 64

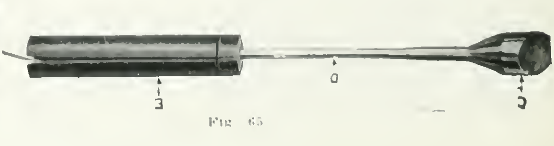


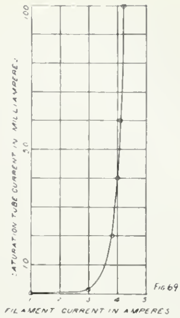
Fig. 65

Fig. 66

between filament current and milliamperage, it is important to note that a very slight change in the filament current may produce a big change in the tube current. To take some actual numbers from the curve of Fig. 69, with filament current 4 amperes, the tube current is 40 ma., while an increase to 4¼ amperes raises the tube current to 100 ma. This has an important practical aspect. Should the filament current fluctuate, there might be marked changes in the tube current; for certain current values "a 10 per cent change in filament current will cause a 300 per cent change in the tube current" (Victor Service suggestions). Obviously this may have disastrous consequences.

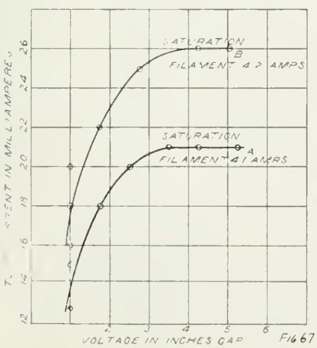
Now, if storage batteries are used as the source of supply for the filament circuit, voltage fluctuations are negligible. Unfortunately, however, storage batteries are not so convenient as a filament transformer, and the latter is now almost entirely used. The supply for the transformer is commercial A. C., in which case voltage fluctuations are inevitable. Most readers will have observed a sudden dimming of incandescent lights when, perhaps in another part of the house, an electric iron or toaster is turned on. The voltage applied to the lamps has lowered because of the greater "load" put on. Now, such sudden changes in voltages are almost inevitable when working with a supply used for many purposes and in many places. In using a Coolidge tube, therefore, with filament transformer and no special means for getting rid of voltage fluctuations, marked changes in milliamperage may occur.

By means of a voltage stabilizer, however, it is possible to maintain a constant tube current in spite of voltage fluctuations. The principle of one type of stabilizer[2] will be clear from a study of Figure 70. In the ordinary tube (high tension) circuit an electromagnet M is placed, near one end of which is a piece of soft iron, the armature A. When a current flows through the tube, M is magnetized and the soft iron piece attracted. Before this piece moves, however, the attraction must be great enough to overcome the tension of a spring S attached to it. Evidently the greater the tension of the spring, the greater the attraction necessary to move the iron, or, in other words, the greater must be the tube current. When A is held away from the magnet (as in figure), the contact point 2 touches the fixed contact point P, so that the *filament* current flows from transformer to 1 to 2 to P to 3 to 4 through filament and back to the transformer. Should the piece A be pulled towards the magnet, however, contact between 2 and P is broken and the filament current must flow through the resistance R. There are, therefore, two possible filament circuits, one including R which we shall call the high resistance path, the other of low resistance where R is excluded. Corresponding to these two circuits, there will be (for any constant voltage) two possible values for the effective filament current, a maximum and a minimum.



To understand the action of the stabilizer it is necessary to remember that the tube current is intermittent, as is nicely shown in Fig. 71, where A represents the alternating filament current, while B shows the intermittent uni-directional tube current. It follows, therefore, that even with absolutely constant voltage, until the tube current has risen to a certain critical value (which depends on the tension of the spring S), the armature is held away from the magnet. During this interval, the filament current follows the low resistance path. Once, however, the tube current exceeds the critical value, the spring attraction is overcome, the armature moves toward the magnet, the contact points 2 and P are separated, the resistance R is introduced and the filament circuit has the high resistance value. During every half cycle, therefore, the contact points are together part of the time, separated the remainder of the half cycle. In other words, the armature is in a state of vibration, and the resistance of the filament circuit fluctuates between the maximum and the minimum value. Hence the effective filament current has an average value, whose magnitude depends on what fraction of the half cycle R is in or out of the circuit. If the voltage is constant, this fraction remains constant, and the effective filament current is constant.

Now suppose there is a sudden rise in the voltage. This causes a momentary increase in the filament current, a greater emission of electrons, a greater



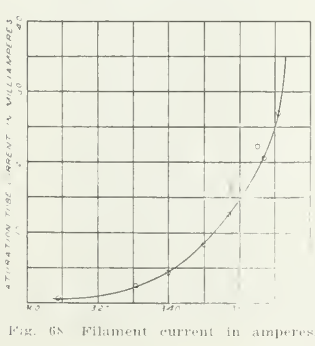
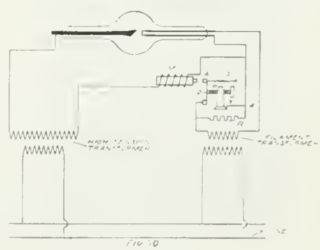


Fig. 68 Filament current in amperes.



tube current, a stronger electromagnet, and therefore an increase in the length of time each half cycle the contact points are kept separated due to the attraction of the armature. The filament circuit, therefore, will have the higher resistance path for a greater portion of the half cycle, and the effective filament current will be kept from rising.

On the other hand, suppose the voltage drops. A momentary drop in the filament current is followed by a lower tube current, and a feebler electromagnet, in consequence of which the armature is held away from the magnet for a longer portion of the half cycle. This time the filament circuit has the low resistance path for a longer part of the half cycle, and so the effective filament current does not drop. Thus automatically, for any given setting of the spring S, the filament current is kept constant. The efficiency of the stabilizer will be seen by a glance at Table IX (taken from the article to which reference has been made) and at Figure 71. In curve B it will be seen that the crests of the curve for the same tube current are all exactly at the same level, thus showing the constant value of the current.

TABLE IX

Without Stabilizer	
Time	Tube Current
0 Min.	10.0 ma.
½ Min.	9.6 ma.
1 Min.	9.3 ma.
1½ Min.	9.0 ma.
2 Min.	8.7 ma.
2½ Min.	8.1 ma.
3 Min.	7.0 ma.

With Stabilizer	
Time	Tube Current
0 Min.	10 ma.
½ Min.	10 ma.
1 Min.	10 ma.
1½ Min.	10 ma.
2 Min.	10 ma.
2½ Min.	10 ma.
3 Min.	10 ma.

Is Rectification Necessary?

71. In Section 64 reference has been made to the rectifying property of a hot filament tube such as the kenotron. It may well be asked, then, cannot the terminals of a high tension transformer be applied directly to the universal Coolidge tube without the necessity of a noisy synchronous motor? As a matter of fact, this can be done *provided the target is kept cool enough.* In practice, however, there is no objection to using the tube with the target extremely hot. Now, once tungsten reaches the temperature of 2000° C. (3300° C. is melting point) it begins to emit electrons. This means that, with the target above this temperature, an inverse stream of electrons is present if no rectifying device is used. Such an inverse current not only gives rise to x-rays from regions in the neighborhood of the cathode (where the inverse electrons hit), but also because of the extreme heat developed at the spot where the electrons hit, increases the danger of a tube puncture. (The danger signal in this case is the appearance of green fluorescence in the neighborhood of the cathode.) With a universal tube, therefore, a rectifying device is necessary; with the radiator tube, however, for reasons given below, this is not the case.

Maximum Input

72. The importance of the question of permissible input should be evident from the last paragraph. As in the case of gas tubes, so in the type we are now considering, every tube has a maximum permissible input. The supply of too much energy (volts x milliamperes x time) may melt the target, vaporize the metal, blacken the tube and so increase the danger of tube puncture. Moreover, in the case of a tube used for the long intervals necessary in therapy, the heat radiated from the hot target may cause a rise in temperature of the glass bulb sufficient to liberate gas and possibly to melt the glass. Fortunately, unlike the practice in the case of gas tubes, the maximum input for each type of Coolidge tube is clearly stated. For example, in the case of the 7" universal tube used for radiographic purposes, when operated with a voltage equivalent to a gap of 6" between points, the milliamperage should not exceed 80 ma. for broad focus tubes, 50 ma. for medium focus, 25 ma. for fine focus. Operation on lower voltage would permit, of course, of corresponding higher milliamperage. When this same tube is used for therapeutic purposes, where the time factor may be large, an input of about one kilowatt is permissible. (1 kilowatt = 1000 watts = 10,000 volts with 100 ma., or 20,000 volts with 50 ma., etc.)

The Radiator Tube

73. In addition to the universal

Fig. 71

Fig. 72

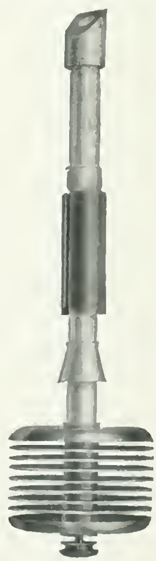


Fig. 73

tube, other types based on the same general principle, are on the market. There is an 8" bulb for high voltage deep therapy work, constructed along lines similar to the universal tube, together with at least four types of what are called radiator tubes. The four types include (a) the right angle dental, (b) the 30 ma. straight, (c) the 10 ma. straight, (d) the 10 ma. portable. As radiator tubes may be operated directly from the transformer and have proved extremely useful, some details in connection with the 30 ma. type (Fig. 72) will be considered. The essential point to realize is that no rectifier is necessary because the target is never allowed to become hot enough to emit electrons. This is done, (1) by limiting the permissible input; 30 ma. must not be exceeded and that at a voltage not exceeding a 5" back-up (between points); (2) by constructing the anode so that heat is conducted rapidly away from the focal spot.

To prevent the rapid rise in temperature of the anode, its construction differs in two important respects from that of the universal tube. A comparison of Figure 73 with Figure 65 will show the decided difference in the appearance of the two anodes. In the radiator tube, the target consists of a small button of tungsten, attached to a solid head of purified copper, which in its turn is electrically welded to a copper rod. Attached to the outer end of this rod which extends through the anode end of the glass tube, are the copper radiators clearly shown in the illustration. Now, copper is not only a better conductor of heat than tungsten but it has also a higher specific heat (see Table V of previous article). For two reasons, therefore, the temperature of the radiator target rises more slowly, (1) because of its greater heat capacity, (2) because of the greater conductivity of copper as compared with tungsten, combined with the radiating device. Regarding (1) we may note that it takes only 10 calories of heat to cause a rise in temperature of the solid tungsten target (plus stem and iron support), while it takes 81 calories for the same temperature change of the radiator anode. In the radiator tube, therefore, because of the comparatively slow rate at which the temperature rises, combined with rapid cooling, an

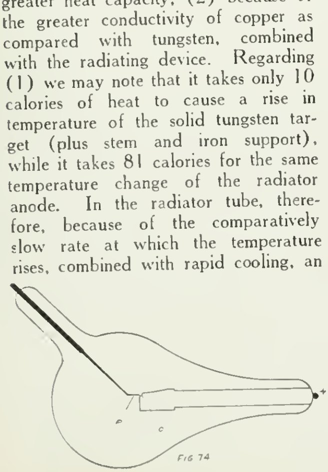


FIG 74

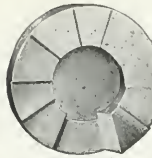


Fig. 75

operator, when making radiographs, begins each exposure with a cool target. "With every current source it permits of the intermittent use of more energy than could in practice safely be carried by a tube with a solid tungsten target of the same size of focal spot." (Coolidge). This means, that for the same amount of energy, a smaller focal spot can be used, with consequent advantage which will be seen later. Moreover, because of the mode of radiation, a much smaller sized bulb may be used, the standard size for the 30 ma. type being 3¾".

On the other hand, the tube for *continuous* use as in treatment will carry less than one quarter of the energy of the universal tube. But, while it is not designed for heavy work and is recommended by Dr. Coolidge for diagnostic purposes, a 30 ma. tube with suitable transformer is an extremely useful outfit for the private practitioner. The gain which results simply from the absence of the noise of a synchronous motor and rectifying disc is in itself worth much.

74. In conclusion, we summarize some of the important advantages of the Coolidge tube. (1) For all types, the maximum permissible input is clearly stated, (2) the tube current (assuming saturation) is independent of the applied voltage, (3) the tube current can be regulated with the same ease as the strength of the current in any simple electric circuit, (4) by means of a stabilizer remarkably constant tube currents may be maintained for long intervals, (5) there are no vacuum troubles, provided the tube is not abused.

The Lilienfeld Tube

75. A brief reference will now be made to a third type of x-ray tube, in which, like the Coolidge, the current consists of a stream of electrons in a highly exhausted tube.[3] The tube consists essentially (Fig. 74) of a *pointed* cathode P placed at a distance of the order of 10 mm. from a small cavity C in the target face of the anode. "The points must be grounded with the greatest care and precision on wires * * * of Wo, Ta, Mo or other refractory metals." Although the cathode is cold, a liberation of electrons takes place from the pointed end, probably because of the electric field which exists between the cathode and anode when a high voltage is applied in the usual way. For the proper operation of this tube, the vacuum must be even higher than that necessary for a Coolidge tube, and in the initial exhaustion very elaborate precautions must be taken. For these and other details the reader is referred to the original article.

The electrons impinge not on a plane target but on a small cavity in the face of the anode whose size depends on the amount of energy to be supplied the tube. With a plane target, Dr. Lilienfeld states that there "is a tendency to form one or more extremely small focal spots", with consequent danger of melting the target. By means of the cavity, not only is the formation of very fine spots prevented by the resulting alteration in the shape of the electric field, but also use is made of secondary cathode rays generated at the spots where the primary beam strikes. In consequence, the whole cavity acts as a focal spot.

The magnitude of the tube current resulting from a given voltage depends on the sharpness of the pointed cathode, on the distance between anode and cathode, and the general geometric arrangement. Unlike the Coolidge tube, however, (assuming saturation current), the tube current in this case is not independent of the voltage but rapidly increases with it. Moreover, it is claimed, the effective voltage is confined more nearly to the crests of the wave-form than is the case with other types of tube, and for that reason (as shall be seen later) the rays are more homogeneous. But the tube is scarcely yet out of the experimental stage—at least as far as information at the disposal of the writer is concerned—and further details would be out of place in a course of this kind.

Footnotes

1—Am. J. Roentgenol. 7:257, June, 1920.

2—W. K. Kearsley, Am. J. Roentgenol. 8:864, Oct., 1921.

3—J. E. Lilienfeld, Am. J. Roentgenol. 9:172, March, 1922.

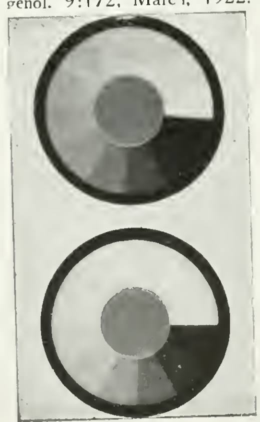


Fig. 76

EDITORIAL

The JOURNAL OF RADIOLOGY

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ANNUAL MEETING
Rochester, Minnesota
December 3, 4, 5, 6 and 7, 1923

The A. M. A. and Radiology

The American Medical Association's formal recognition of radiology as an integral part of medicine completes the laying of the foundation on which American radiology will build in future years.

The following is a copy of a portion of the report of the Reference Committee on Sections and Section Work as adopted at the annual meeting of the American Medical Association held in San Francisco, June, 1923:

> "After careful consideration of the report of the Council on Scientific Assembly, we concur in all of the recommendations presented.
>
> 1. We especially endorse the recommendation that no changes be made in the number of sections of the Scientific Assembly. This opinion already has had the approval of the House of Delegates as expressed at the St. Louis session.
>
> 2. We feel, however, that the Association should recognize the increasing importance of special medical activities, such as radiology, physiotherapy and occupational therapy; and to that end we wish to express our approval of that portion of the resolution offered by Dr. Van Zwaluwenburg which provides that, wherever possible, every section program should contain at least one paper on a subject pertaining to some other specialty of particular interest and importance to members of the section, and your committee makes such recommendation.
>
> 3. In view of the fact that laymen are attempting to practice radiology, we recommend that the American Medical Association recognize the science of radiology as an integral part of medicine and surgery."
>
> Respectfully submitted,
> Albert E. Bulson, Jr., Indiana, Chairman,
> C. E. Mongan, Massachusetts,
> L. H. McKinnie, Colorado,
> A. W. Booth, New York,
> Philip Marvel, New Jersey.

Recognition of radiology as an integral part of medicine by the largest body of medical men in the United States should be conclusive evidence to the members of the profession that radiology as a science in itself has been thoroughly tried and found worthy.

In view of the fact that similar action was taken some time ago by the American College of Physicians and the American College of Surgeons, every radiologist has a right to feel a new dignity in his work now that the American Medical Association officially bids him enter and present what he may for the advancement of the science as a whole.

Thus a new responsibility is laid upon every radiologist's shoulders, for though he makes no claim to hold the master cure-all for every human ill, he must now sooner or later recognize the fact that his work brings him into almost daily contact with every phase of medical science and that he should have some real information to impart with respect to the advantages and disadvantages of the agents within his control.

A hard rule, surely, but radiology is no place for the physical coward, the mental sluggard, or the moral leper. Its exactions call for unusual fortitude, physical energy, a mind that is never satisfied with past achievements but drives constantly forward to greater things, and more than all else, an indomitable will which holds to the pursuit when pursuit seems utterly useless.

Many of the baffling problems in radiology have been met so that today radiology in some or all of its phases is universally accepted by the profession diagnostically and therapeutically. However, for those who have grown up with the science and have kept their feet on the ground with respect to the proper relation between radiology and medical science as a whole, a tremendous field lies just ahead to be explored and the good thereof applied to the fulfillment of human relief.

That is why the action taken by the American Medical Association provides a source of such great inspiration to the members of the Radiological Society, for it is probably due largely to their efforts that this report was adopted. We take this opportunity to express to the American Medical Association our appreciation.

Clay Emory Giffin, M. D.

On July 22nd Dr. Clay Emory Giffin of Boulder, Colorado, was drowned while attempting to save his thirteen year old son, Elbert, from a like fate.

The family and a few friends had gone for a picnic supper on the banks of Boulder Creek above Eldora. The boy had gone in wading while the doctor stood nearby watching him. Suddenly the lad stepped into a beaver hole and the undercurrent swept him down. Dr. Giffin plunged in to save his son but the undercurrent caught him also and in spite of the truly heroic efforts of his companions he was drowned and for more than an hour it was impossible to recover his body, and then only by dragging the stream with barbed wire. The son, however, was saved.

Dr. Giffin was born in Boulder, March 31, 1882, the son of Dr. and Mrs. L. M. Giffin. He was educated at Mapleton grade school, Boulder Preparatory School and the University of Colorado where he was a member of the Delta Tau Delta, popular among his fellow students and a leader in his class work. He received the degree of A. B. from the University of Colorado in 1905 and

in 1907 was granted the degree of M. D. by the University of Colorado School of Medicine, in which his father held the position of dean for a number of years.

In 1909 he was married to Miss Vera Greenman of Boulder. The two had been classmates throughout most of their school days. Two children, Elbert and Clay, Jr., were born to them. He is survived also by a brother, Horace, a half-brother, Luman, a sister, Mrs. Emory Lines and a half-sister, Grace.

Dr. Giffin entered the practice of medicine with his father and this association continued until the father's death in January of this year. The doctor was intensely interested in his profession and rapidly rose to prominence. He had been a lecturer at the University School of Medicine for a number of years and had recently been appointed Chief of Staff of the Boulder County Hospital. He was a member of the American Medical Association and of the Radiological Society of North America. During the years 1919 and 1920 he acted as the Radiological Society's counselor for the states of Colorado and Wyoming, and he also served as a member of the editorial staff of the official organ of the Radiological Society, the Journal of Radiology, up to the time of his death.

He was a scholar, a man of high professional and personal ideals and beloved by all who came in contact with him. In the death of Dr. Giffin the community has lost one of its most prominent and loved citizens and the Radiological Society of North America has lost one of its most loyal members.

Annual Meeting American Roentgen Society

Among the forthcoming important meetings of special societies is the annual convention of the American Roentgen Ray Society. This is to be held in Chicago from September 18th to 21st, with headquarters at the Congress Hotel. A number of eminent foreign contributors will appear on the program, and the announcements indicate that treatment by high voltage x-ray will have a prominent place on the program. Among the papers to be read are the following:

"Some Aspects of the Cancer Problem"—Robert Knox, M. D., London.

Title to be announced—Prof. Walter Friedrich, Germany.

"Radium and Roentgen Rays as Different Agents in Superficial and Deep Therapy"—Albert Bachem, Ph. D., Chicago.

Title to be announced—Henry J. Ullman, M. D., Santa Barbara, Cal.

"A Review of Therapy as Seen on the Continent"—I. Gerber, M. D., Providence, R. I.

"The Effect of Roentgen Rays on Bone Marrow"—Ernest Falconer, M. D., Laird H. Morris, M. D., Howard E. Ruggles, M. D., San Francisco.

"Technique of High Voltage X-Ray (Combined with Radium)"—Charles Goosman, Cincinnati.

"Therapy of Abdominal Tuberculosis and Tuberculosis of the Foot (Bone)"—Geo. H. Steele, M. D., Oshkosh.

"Cancer Therapy from the Surgeon's Standpoint"—Emil Beck, M. D., Chicago.

"Measurements of Four Different Types of High Voltage X-Ray Machines by the Duane Method and the Friedrich Iontoquantimeter"—George E . Pfahler, M. D., Philadelphia.

"Roentgen Cachexia"—Charles L. Martin, M. D., Dallas.

"X-Ray Treatment of Fibroids of the Uterus and Uterine Bleeding Not Due to Malignancy"—John G. Williams, M. D., Brooklyn.

"Effects o f the Shorter Wave Therapy on Gastric Secretion of Dogs"—Sidney Portis, M. D., and Robert Arens, M. D., Chicago.

"The Platinocyanide Pastille in Deep X-Ray Therapy"—A. H. Pirie, M. D., Montreal.

"High Voltage Treatment in a Series of Sarcoma Cases"—W. S. Lawrence, Memphis, Tenn.

"The Control of Hyperthyroidism"—Kennon Dunham, M. D., Cincinnati.

"Evolution of X-Ray Therapy"—Albert Soiland, M. D., Los Angeles.

"Hepatic Changes in a Case of Lymphosarcoma Treated by Deep Irradiation"—James T. Case, M. D., Battle Creek, Mich., and A. S. Warthin, M. D., Ann Arbor, Mich.

"Technique and Statistics in the Treatment of Superficial and Accessible Malignancy with Radium, Roentgen Rays and Electrothermic Coagulation"—J. Thompson Stevens, M. D., Montclair, N. J.

"Dosage Methods, a Comparison and Deduction"—Otto Glasser, M. D., Cleveland.

Title to be announced—Charles A. Waters, M. D., Baltimore.

"The Problem of Deep Therapy"—Gustav Bucky, M. D., Germany.

"The Value of X-Ray in the Diagnosis of Atypical Pregnancies with Report of Two Cases of Anencephaly Before Birth"—Davis Spangler, M. D., Dallas.

"Organic Hour Glass Contracture of the Stomach with Some Reference to the Surgical Treatment"—Howard P. Daub, M. D., Detroit.

"Multiple Osteomyelitis"—Preston M. Hickey, M. D., Detroit.

"Bone Dystrophies of Small Pox"—John W. Cathcart, M. D., El Paso, Texas.

"Hydronephrosis"—Bernard M. Nichols, M. D., Cleveland.

Title to be announced—A. B. Moore, M. D., Rochester, Minn.

"A New Water Cooled Tube"—C. N. Moore, M. D., Schnectady, N. Y. (General Electric Co.)

"X-Ray Evidence of Colonic Secondary Reactions"—R. Walter Mills, M. D., St. Louis.

Title to be announced—Arial W. George, M. D., Boston.

"An X-Ray Study of 1500 Children Before and After Tonsillectomy Under Ether"—J. H. Green, M. D., Rochester, N. Y.

"Back Injuries"—William B. Bowman, M. D., Los Angeles.

"The Upper Left Quadrant"—E. C. Koenig, M. D., Buffalo.

"X-Ray Study of the Thymus Gland"—George W. Grier, M. D., Pittsburgh.

"Lateral Roentgenography in Pulmonary Abscess"—L. T. LeWald, M. D., New York City.

"Carcinoma of the Gastro-Intestinal Tract Accompanied by Bone Metastases"—E. L. Jenkinson, M. D., Chicago.

"Differences in Destruction of Cartilage in Tuberculosis and Pyogenic Arthritis"—P. B. Phemister, M. D., Chicago.

"Tuberculous Lobar Pneumonia"—L. R. Sante, M. D., St. Louis.

"Observations Upon Opaque Residues in the Colon: Report of One Case Harboring an Opaque Meal in the Colon for Five Weeks"—E. H. Skinner, M. D., Kansas City, Mo.

"Dental Pathology as Revealed by the X-Ray Examination and Underlying Principle of Treatment"—A. F. Tyler, M. D., Omaha.

"Some of the Pitfalls in the Roentgenographic Diagnosis of Colonic Lesions with Suggestions as to the Proper Method of Overcoming the Same"—Wm. H. Stewart, New York City.

"Healed Miliary Tuberculosis of the Lungs"—E. B. Blaine, M. D., Chicago.

"Is Haudek's Niche as Diagnostic of Ulcer as Believed?" Anthony Bassler, M. D., New York City.

"Chondrogenesis Imperfecta (Achondroplasia)"—Philip Lewis, M. D., and E. L. Jenkinson, M. D., Chicago.

"Reasons of Lack of Positive X-Ray Findings in Many Cases of Low Back Pain"—Paul B. Magnuson, M. D., Chicago.

"Teleoroentgenography as An Aid in Orthopedic Measurements"—Preston M. Hickey, M. D., Detroit.

Title to be announced—Lewis G. Cole, M. D., New York City.

"The Future Relations Between the Medical and Dental Professions"—Byron C. Darling, M. D., New York City.

"Extraction of Foreign Bodies from the Organism in Daylight with X-Rays"—Carlos Heuser, M. D., Buenos Aires.

The X-Ray in Africa

"Accept our thanks for your gift of $1,000 for equipment. We are planning with this to put in the much needed x-ray apparatus. We have so many fractures here, due to the environment these people are living in. They are brought to the hospital and we set the bones by the eyesight in the tips of our fingers, but what a joy it would be to actually see the whole mischief by the x-ray. This is a cocoanut country and thousands of cocoanut trees grow up and down this coast. The trunks of the trees are without limbs, from twenty to sixty feet high, and the boys must climb these trees, which are like greased poles, to gather the fruit. This must be done very often, and when they fall from one of these trees they are quite badly smashed up. The other day I was called up country to see a boy who had fallen from a tree; his arms and several ribs were broken, and this happened four days before I was called.

"Or again, an example like Tinga. One morning he was led in by a boy; his clothes had been torn off from him and he was bleeding from his face, his eyes were tightly swollen shut and his arms and hands were swollen to twice their normal size. His story was that he had just returned from Johannesburg and had fallen among thieves. They tied him down with wires and tried to gouge out his eyes, also pounded him with clubs in the endeavor to make him tell where he had his money. Tinga, today, with one eye and one arm paralyzed (due to the fact that we did not have an x-ray to see the real mischief) can be found at an outstation doing his bit.

"The above illustrations will show you how much we need this apparatus."

C. J. STARFFACHER, Inhambane, Africa.

*Missionary News, July, 1923.

Technician's Certificates

It has been my good fortune to see the certificates which are being issued to technicians who have successfully passed the examination given by the Registry of Radiological Technicians. The certificates are engraved on pure white vellum paper 8 by 11 inches in size and are signed by the officers of the registry. It will be recalled that this board was fostered by the Radiological Society of North America but that the American Roentgen Ray Society, the Canadian Radiological Society and The American College of Surgeons are cooperating.

The certificate must be renewed annually and is of value only when the holder is employed by a properly licensed medical or dental radiologist. The certificate is proof that the holder has attained a high grade of proficiency in the technical work connected with the practice of radiology

American Roentgen Ray Society

THE ANNUAL MEETING of this organization will take place in Chicago, September 18th to 21st, inclusive, and it is prophesied that this will be a banner year in its history. The meeting is to be held in the Congress Hotel, on the lake front.

Dr. Hollis Potter, president-elect, and chairman of the program committee, has planned that the program shall have fewer papers and more detailed discussion than has been the plan heretofore.

Central Illinois Radiological Society

THE Central Illinois Radiological Society at a recent meeting elected the following officers:

President..........James H. Finch, M.D., Champaign
Vice-President........Harold Swanberg, M.D., Quincy
Secretary-Treasurer......P. B. Goodwin, M.D., Peoria

NEW EQUIPMENT

Acme-International Precision Type Micro-Timer

THE Acme-International X-Ray Company has recently completed the development of their Precision Type Micro-Timer, which now is offered to the profession as an instrument especially accurate on extremely short exposures.

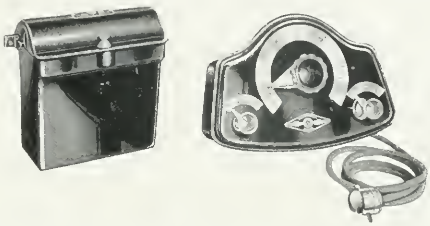
This apparatus is a serial timer of more than normal accuracy. The Timer has two ranges; the upper from 0 to 3 seconds in steps of 1/20 seconds and the lower from 0 to 30 seconds in steps of ½ seconds. The change from high to low is made by means of a simple switch on one side of the case.

Setting of the Timer for the exposure required is made by a handle with an indicator which actuates a ratchet mechanism. This enables the operator to make the setting either on the dial or by counting the clicks, the latter being the method preferred in some laboratories. The Timer is driven by a constantly operating motor started by a switch opposite the scale changer on the case. Fluctuations in voltage do not affect the speed of this motor, and, therefore, do not affect the accuracy of the Timer.

The timing element is put into operation by an electro-magnetic relay which operates instantaneously, and, as the parts of the timing element are extremely light and the motor speed is unaffected by load there is no loss of time due to inertia. The above points, coupled with the simple construction of this instrument, assure extreme accuracy on very short exposure and prevent its getting out of adjustment.

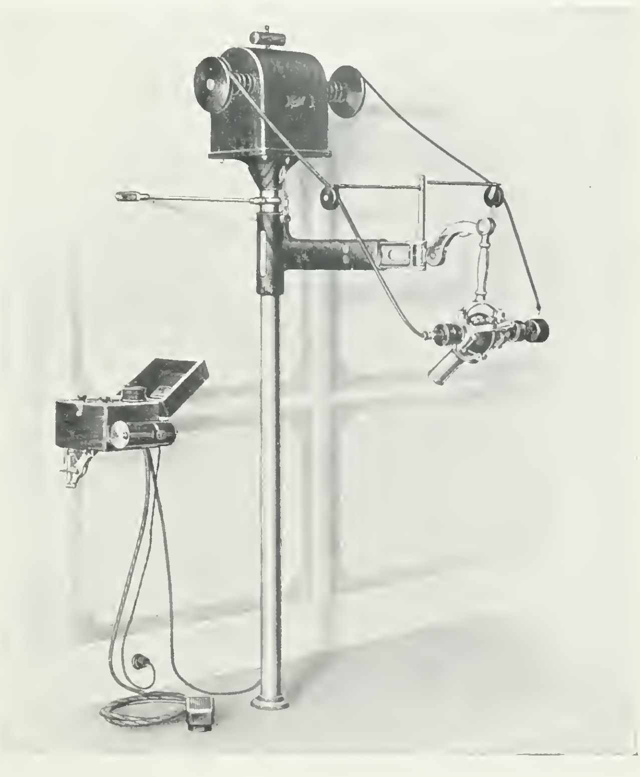
When the indicator is set at the required time on the dial the timing element is put into operation by pressure on either a push button at the end of the cord or by a foot switch on the floor. The exposure is automatically terminated at the end of the period for which set by an oil immersed circuit breaker built as a separate unit but included in the timer circuit. Release of the push button automatically resets the timer and as many exposures as desired of the same time can be made without resetting the indicator.

In case of emergency the exposure can be terminated at any time simply by releasing the pressure on the push button or foot switch. When fluoroscopic work is to be done the indicator is set at a point on the dial marked "Fluoroscopic." The circuit breaker then operates directly with the push button or foot switch and remains closed until the pressure is released, when the exposure is automatically terminated. This instrument is finished in black enamel, polished aluminum and nickel plate.



Campbell Dental X-Ray Machine

Briefly, the principle features of this outfit are that the transformer and high tension wires are high up and well out of the way, that the transformer has a capacity of 30 milliamps with a 3", 4", and 5" back-up which can be varied as desired, thus fitting the machine to do any class of



work and not limiting the operator to merely dental work as is the case with the 10 ma. 3" back-up machine. The tube stand is specially well designed for convenience in getting any desired position for both dental and general radiographic work. The outfit takes up a very small amount of floor space, uses the 30 ma. Coolidge tube, and the currents are all very easily operated from the control box mounted on the wall as shown in the picture, exposures being made by the foot switch. The price of this outfit, complete, as pictured including a 30 ma. Coolidge tube and lead glass tube shield is $875.00.

Poetable Ionization Chamber for Deep Therapy X-Ray Measurements

DR. A. MUTSCHELLER, of the Research Laboratories of the Wappler Electric Company, has designed a special new instrument, the Portable Ionization Chamber, for standardizing and measuring the characteristics of deep therapy x-ray machines. Accurate measurements have been impossible with the measuring instruments heretofore available, such, for example, as the iontoquantimeter, the selenium cell, or the large beam ionization measuring chamber.

The most important factors for which deep therapy x-ray machines should be tested are:

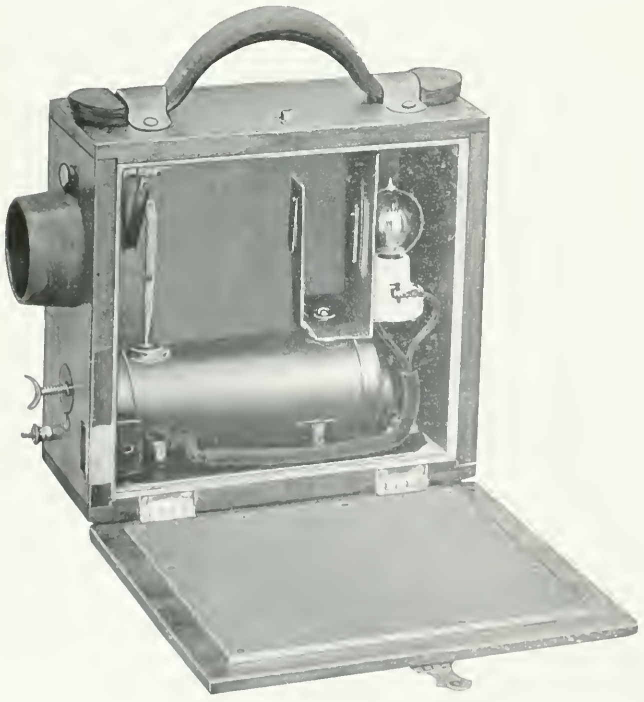
1. The correct filter thickness for the machine under consideration.

2. The effective wave length of the x-radiation.

3. The percentage of useful x-radiation which passes through the proper filters when used with that machine.

Dr. Mutscheller has worked out a method by means of which these three important factors may be determined with the Portable Chamber and publication of this method will shortly be made.

The Portable Ionization Chamber has, first, a carefully constructed metal ionization drum. Mounted directly upon it is a thin metal leaf so illuminated that its shadow is projected upon a scale readable from the exterior of the lead lined box in which is mounted the ionization drum, leaf, etc. The leaf is so protected that when not in use the entire apparatus can be carried about without risk of damage. It is interesting to note here that a thin metal leaf superior to gold leaf has been found for the proper application of Dr. Mutscheller's method of testing x-ray apparatus with the Portable Ionization Chamber. This metal leaf, it has been found, indicates a much more nearly correct measurement than does any other indicating device. The charging mechanism is very simple and positive.



Dr. Mutscheller's object in designing the Portable Ionization Chamber was to put at the disposal of every radiologist an instrument which would enable him to test the radiation produced by his own x-ray apparatus, to accurately record the dosage, and to exactly duplicate the radiation used by any other radiologist as recorded by means of the Portable Ionization Chamber.

It has been charged that no two radiologists use the same x-ray radiation, nor are capable of reproducing the same x-ray radiation used by another. This may account for the many failures reported in x-ray therapy. Failure for any such reason could have been avoided if the proper measuring instrument had been available.

It is our belief that in the Portable Ionization Chamber, as briefly described, the proper instrument is available, and that in the future it will be entirely possible for the radiologist to accurately record the dosage used so that an exactly similar dosage can be reproduced at any time and at any place.

ABSTRACTS *and* REVIEWS

First Aid X-Ray Atlas of Fractures and Dislocations. First Aid X-Ray Atlas of the Arteries. By H. C. Orrin, O. B. E., F. R. S. C., (Edinborough). Surgeon, Ministry of Pensions Orthopedic Hospital; Late Civil Surgeon to the London General Hospital; Examiner in First Aid to the Injured, Etc., Etc. Price, $1.00 each. 1923. Paul B. Hoeber, New ork.

THESE are two little 16 mo books, the one on fractures comprising 76 pages and 46 figures, the one on the arteries comprising 46 pages and 11 figures. They are very legibly printed on paper of good quality and bound in stiff board covers.

They are what the names imply—first aid atlases presenting x-ray anatomical studies of the chief bones and arteries of the human body.

Normal and fractured bones are pictured side by side. Causes, signs and treatment are described in the text and illustrations of bandaged fractures are given.

In the second book named, the main arteries and their branches are pictured in roentgenograms, their relationship to the osseous system is precisely shown, the course of each is described and the pressure point for control of hemorrhage is pointed out. One chapter is devoted to an anatomical description of the heart.

The books are adequately indexed and are very useful little volumes for the purpose in view.

Digestive Disturbances in Infants and Children. Roentgenologically Considered. By Charles Gilmore Kerley, M. D., Consulting Physician to the Babies' Hospital, New York; Leon Theodore LeWald, M. D., Professor of Roentgenology, New York University, Roentgenologist to St. Luke's Hospital, New York. With a Note on the Surgery of Infants by William A. Downes, M. D., Clinical Professor of Surgery, Columbia University, Attending Surgeon Babies' Hospital and St. Luke's Hospital, New York. Quarto. Extra Cloth. Price $12.00. New York, Paul B. Hoeber, 1923.

THIS is the third volume of the Annals of Roentgenology (Vol. I, *Mastoids* by Law; Vol. II, *The Pathological Gall-Bladder* by George and Leonard), edited by James T. Case, M. D. The binding as in the preceding volumes is very handsomely done in extra cloth, paper of extra heavy stock printed in large type. The illustrations are well done.

In his preface the editor remarks that only the rare roentgenologist can hope to specialize in more than one or two branches of his art and must therefore often seek aid outside of his own experience and early training in roentgenology. To such men this book supplies a diagnostic guide in dealing with gastro-intestinal disturbances in infants and children.

The authors in their extensive experience with this phase of gastro-intestinal work have found that the usual diagnostic methods fail to lead the way to proper therapeutic measures. They found also that many cases of chronic gastro-intestinal disease have their origin in childhood and that roentgen diagnosis at this period of life often points the way to early elimination of such disease conditions, thus insuring freedom from otherwise inevitable gastro-intestinal trouble in adult life.

The actual text with its 80 pages interspersed with 49 illustrations describes the technique of the roentgen examination in so far as it differs from the technique used in adult cases. Specific description, so far as the roentgenological diagnosis makes it necessary, is given of the various diseases which the atlas illustrates.

The headings of this textual portion of the book are as follows: Preface—A Note on the Surgery of Infants; Chap. I—Technique; Chap. II—Esophagus (atresia, stenosis, cardiospasm); Chap. III—Stomach (congenital hypertrophic pyloric stenosis, pylorospasm, chronic dilatation, ptosis, syphilis); Chap. IV—Intestinal Tract (dilatation and ptosis of cecum, appendicitis, congenital dilatation of colon, Hirschsprung's disease, intussusception, volvulus, non-rotation of colon); Chap. V—Influence of Posture on Digestion; Chap. VI—Hernia of the Diaphragm; Chap. VII—Tuberculous Peritonitis; Chap. VIII—Transposition of Viscera; Chap. IX—Abdominal Tumors; Chap. X—Foreign Bodies in the Alimentary Tract.

The atlas portion follows this section and is arranged, in general, upon an anatomical basis with a practical use of letters and arrows. It consists of 54 plates totaling 117 figures accompanied by captions totaling about 50 pages of print in English, French and Spanish. These captions give the clinical history (in some instances completely followed up), the roentgen findings, treatment instituted and a paragraph of comment upon the whole case. The roentgenologic diagnosis of each case has been proved either by prolonged clinical observation or by operation.

The Twenty-Fifth Anniversary Dinner. Editorial, J. Roentgen Society, 19:99-108, July, 1923.

THE oldest radiological society in the world, the Roentgen Society of Great Britain, celebrated its twenty-fifth anniversary in March of this year with many distinguished visitors and members present.

A most enthusiastic meeting, filled with a spirit of hope and good will, is reported in the July journal of that society and anyone who gives too great credence to the legend of the Englishman's lack of a sense of humor should read the above account to enjoy the sparkle manifested at the dinner given in celebration of that anniversary.

Sir Humphrey Rolleston, the President of the Roentgen Society, in his toast to the Society, laid much stress upon the fact that from the very beginning the Society had combined in its membership medical men, physicists and instrument makers and had stood for "team-work" long before that phrase became a catch-word.

Prof. F. A. Soddy, past-president of the Society and winner of a Nobel prize, responded to this toast. The combination always existent in the Society and working harmoniously together argued well, he thought, for that future time when the world, tired of the present mess it is in, should decide upon getting back to a sane mode of living. Doctors and engineers play a mighty part in sociology and there is going to be still greater opportunity for them to exercise their powers and influence upon social progress as time goes on and the world settles down. Prof. A. W. Porter in his response recalled the early days of x-rays and commended the work done by the Society.

Dr. Robert Knox proposed the toast to the visitors and after a tribute to the physicists present gave a brief summary of Dr. Forssell's work in the field of Swedish radiology, referring

to Stockholm as a world center of radiology with Dr. Forssell at its head. Dr. Forssell responded by saying that no society in the world had a better right to look backward with satisfaction and forward with hopefulness than had the Roentgen Society and as proof recounted the names of Thomson, Rutherford, Barkla, the two Braggs, Aston, Soddy, Mackenzie Davidson, Lewis Jones, Deane Butcher, C. R. C. Lyster, Ironside Bruce, Holland, Knox, Barclay, Russ and Kaye, and others. The bridge to the promised land in radiology, he said, leads by way of special institutions for research and teaching and Great Britain is on the right track. Prof. W. Eccles (Vice-President of the Institution of Electrical Engineers) also responded recalling inspiring memories of Prof. Silvanus Thompson. He told of how a student of Thompson's went out to South Africa in the days of the Rhodesian gold rush, and, "being of too trustful a temperament, joined a small party in a trek for gold. One morning he awoke to find himself deserted and robbed, and he could do nothing but tramp to the coast, living on such small animals as he could kill and eat and avoiding such large animals as would have killed and eaten him. When he arrived back in civilization he was indeed a curious figure, with his long hair and virtual nakedness, but he had a large book under his arm, *Dynamo-electric Machinery*, by Silvanus Thompson.

Dr. F. W. Aston, noted physicist and winner of a Nobel prize, toasted the past-presidents of the Society in a very witty speech to which Dr. C. W. Mansell-Moullin and Mr. A. A. Campbell Swinton responded. The former referred to the fact that "when the Society was young and small it was snubbed by the bigwigs of the medical profession, and boycotted by the medical journals, and for this reason it succeded." Dr. Swinton referred to Dr. Aston as a "prince of experimenters", citing especially his work on the isotopes of the elements.

Dr. C. Thurston Holland proposed the health of the President, Sir Humphrey Rolleston, saying that his presence in the chair would add to the prestige of radiology throughout the world and paying tribute to him as a great leader, a writer and a man.

Dr. Holland said that of two speeches he might make he had chosen the longer one in response. The shorter one was "I thank you", the longer one "I thank you very much" —and if the bigwigs of the medical profession had once snubbed the Society, the Society was not retaliating in like kind, proof of which was that they had asked him to accept the presidency

X-Rays and Diagnosis. C. Thurston Holland, M. D. (Sixth Silvanus Thompson Memorial Lecture), J. Roentgen Society, 19:123-148, July, 1923.

DR. C. Thurston Holland, "the father of radiology in England", discussed his subject under four divisions, namely, the bones, the thorax, the gastro-intestinal tract, and stones in the genito-urinary tract.

The universal application of radiography to bone injuries and disease is not altogether an unmixed blessing, he believes, because the present day medical student does not cultivate the same accuracy of observation which used to be necessary and which at times still is necessary in dealing with bone lesions. The usefulness of x-rays in the field of bone lesions has never been questioned from their first advent.

The first kidney stone shown by x-rays and later removed at operation was done by McIntyre of Glasgow in 1896. Leonard of Philadelphia did the pioneer work in establishing the x-ray diagnosis of stone and today "radiology is the only method of examination which can be relied upon to demonstrate the presence of stone in kidneys or ureters. * * * Exploratory operation for kidney stone is a thing of the past."

Stones may be multiple, may exist in only one side or in both or may be in one kidney and the opposite ureter. Symptoms may appear on one side and the stone be in the opposite side. Pure uric acid stones cannot be shown by the x-ray; it is well to remember this in cases which yield no findings under the rays.

Gross intrathoracic lesions may not be diagnosable by ordinary means but the lesion may be unmistakably revealed by x-rays. "Radiography has set a very distinct limit on the value of both auscultation and percussion, and it has proved beyond any possibility of argument, that, valuable as they are, they cannot be relied upon to reveal the whole truth and nothing but the truth." Early aneurysm of the thoracic aorta is mentioned as reliable as positive diagnosis in this connection. Negative diagnosis is almost as reliable as positive diagnosis.

In pulmonary tuberculosis clinical diagnosis is often a matter of conjecture and often when physical signs are lacking the x-rays will show extensive involvement. In a case of recognized pulmonary tuberculosis the x-rays will reveal more than the most skilled clinician can possibly detect unaided. The plates may not always differentiate between an old quiescent case and one which is active but taken in conjunction with other signs they will in most cases clear up whatever doubt there is. In suspected root infection they alone can decide. In the employment of artificial pneumothorax the use of the rays is of such importance that "to neglect to use radiographic control is criminal". It is not sound medicine to expect the x-ray findings to stand alone in the diagnosis of pulmonary tuberculosis. They must be considered together with the other facts and can not otherwise demonstrate their true value.

In his conclusion regarding this subject the author says that "no case of phthisis should be treated without x-ray examination and without x-ray control. * * * if the most important single method of examination is a duel between the stethoscope and the x-ray in competent hands the x-ray wins easily. Give me the history, let me see the patient, let me make an x-ray examination; you can have the same advantages but a stethoscope instead of x-rays. I know who will have the best of it." Every hospital or sanatorium for consumptive patients should be fully equipped to do this x-ray work with a skilled radiologist in charge of the department.

English dentists have been very slow to recognize the x-ray but modern dentistry is impossible without this aid. "Except from the point of view of a simple stopping no tooth should be treated without an x-ray examination both before and after treatment. Crowning teeth without a previous x-ray examination is absolutely malpractice; the clearing out of root canals and the putting in of root fillings comes under the same catagory. Bridge work is anathema. A very short experience of undiscovered mysteries of dental conditions as seen by the radiologist would quickly lead to the above dogmatisms." If these conditions were adhered to there would be less arthritis or osteo-arthritis.

Esophageal diagnosis is another triumph of radiology.

Sir Berkeley Moynihan is quoted to illustrate Dr. Holland's own views upon gastric diagnosis. The quotation reads: "In the diagnosis of gastric ulcer it (x-ray diagnosis) has pride of place, in competent hands it is far more accurate than any other method of diagnosis, clinical or chemical, or than all other methods combined. It is, indeed, so trustworthy that unless a diagnosis of gastric ulcer made upon clinical evidence is confirmed by the radiologist it should rarely, if ever, be accepted" With delightful humor

Dr. Holland goes on to contrast present day insistence upon roentgen examination of the gastro-intestinal tract with the attitude met with in earlier days when learned anatomists looked askance upon the radiologist attempting diagnosis in this field.

Regarding the hour-glass stomach he says the common typical constriction with ulcer or ulcers is rarely malignant, especially in women, and should be operated upon. However, the atypical hour-glass without a definite cavity and with ragged edges at the site of the constriction is a subject of suspicion, especially in males.

Chronic atony of the stomach without accompanying organic disease does not exist.

In duodenal ulcer the chief function of x-ray diagnosis is confirmatory.

Prejudice, jealousy, honest disbelief, all have stood in the way of x-ray diagnosis but, as is always the way with truth, it has come into its own. One great stumbling block has been and still is that all x-ray work is not of the same standard of excellence. The technique, plates, and interpretation of some workers are not to be relied upon and yet are relied upon, sometimes in high places. "The younger generation of our profession has grown up with a knowledge of x-ray diagnosis which their predecessors did not have and the future of radiology is full of promise. In conclusion, then, is one word of warning which I would say. At present in our teaching hospitals a little too much is being asked from radiologists; it is often the case that they are expected to make diagnosis from the x-ray alone. This is not fair and it is not calculated to advance either the art of radiology or that of medicine. The x-ray is one method used for arriving at a correct diagnosis, and although it is both dramatic and final in many cases, in others it is to a large extent influenced in its reading by a knowledge of other facts. The other part of my warning is that students are being taught too much to rely upon the x-ray departments for their diagnosis and are neglecting to develop to its full the art of observation and deduction so wisely used by our ancestors."

The Journal of the Roentgen Society in its July number has paid a tribute to the Journal of Radiology by quoting verbatim the account which appeared in the editorial section of our May number relating the Sultan of Sulu's one-time adventure in the x-ray field.

Wilhelm Conrad Roentgen. Goesta Forssell, M. D., Acta Radiologica, 2:101-109, No. 6, May, 1923.

DR. Goesta Forssell in this article has given an interesting and human sketch of the late Wilhelm Conrad Roentgen and bestows upon him rare praise not alone as a scientist but as a man.

An excerpt from a recent letter of Roentgen written to E. L. Albert, a friend of his youth and also a friend from childhood of the physicist August Kundt, to whom Roentgen ascribes his own success, reveals some of the beautiful qualities of Roentgen's personality. The letter reveals a warm heart, capable of much sympathy and gratitude, and a personality winsome in its modesty where in many men the opposite would have been found. The letter also gives us an intimate glimpse of the present day conditions surrounding men of Roentgen's class in his native land. To translate Dr. Forssell's comment on this: "The few lines of Roentgen's letter in which he touches upon the present conditions allow us a distressing glimpse behind the curtain back of which the tragedy of his native land is being played out to its end. They picture to us the heroic and silent battle now being waged by the men of learning in Germany, a battle not only against poverty, but against that great weight of depression which Germany's situation brings home to them."

The following is a free translation of an excerpt from Roentgen's letter written to Albert in November, 1922: "For the past two and one-half years I have retired from active life and can do but little physical work; to this is added the depressing circumstances under which we Germans now must labor, for not only must we endure poverty (no new experience) but in deep grief our hearts ask what is to be the future of this people, and how shall they ever re-establish themselves? It indeed requires great courage and faith to walk unbowed these days."

"The gay and happy days of our youth, which your letter recalls, are now only a memory, but a memory that awakens music in my old heart. A number of years ago, to my great joy, Besser was my guest (Besser was a friend of student days, later a prosperous business man, but now long dead) and we lived again in memory the years we spent together in Zurich. All three of us have no need to complain of that which life has dealt us, and least of all should I be discontented when I reflect that at that particular time my future appeared very uncertain. Do yau remember that it was through you that I was put in touch with Kundt? It was he who guided me through the field of physics and who led me out of the mist of my uncertainty regarding my future."

Roentgen, says Albert, was a staunch and true friend—a most modest student who never sought to dazzle others by his brilliancy as he might have done. Albert adds that, much as he was liked by the student set, "he had no liking for noisy diversions, dancing, for example."

Such men as Roentgen, concludes Dr. Forssell, are bright stars of hope lighting the way to a better future for their native land, their influence must bear fruit.

It is interesting to note here that the Roentgen Society in England has appointed a committee to consider the setting up of a "Roentgen Award" to commemorate the man to whose research the world is debtor.

Some Remarks on Processus Posterior Tali. Chr. J. Baastrup, M. D., Acta Radiologica 2:166-173, No. 6, May, 1923.

THE literature upon fracture of this process is reviewed and the author reports two cases coming under his personal observation and examination.

After this form of fracture there are seen fragments joined to a large and plump bone projection which usually will cause a diminished plantar flexion on account of plantar disproportion. Such a condition of the process may also be congenital. Surgical removal of the process is the only effective treatment.

Whenever there occurs a fracture of the hindmost edge of the tibia the posterior process of the astragalus should be examined for fracture, and vice versa.

X-Ray Diagnosis of Bone Lesions. Robert W. Lovett, M. D., Illinois M. J., 54:48-49, July, 1923.

CHANGES in bone and their relation to clinical phenomena are discussed under atrophic changes, destructive changes and formative changes.

In atrophic changes "where the bone shadow diminishes, the contrast between the cortex and the medulla becomes extremely sharp and in the severer cases the medulla casts little more shadow than the soft parts. This accompanies injury, disuse, and is seen in disease—particularly tuberculosis."

Destructive changes are either general or local, may involve a large area or a small one producing perhaps notched out areas. Tuberculosis most often is responsible for these changes though they may be caused at times by osteomyelitis, syphilis and sometimes by arthritis deformans.

Formative changes increase the outline or density of the bone. Arthritis heads the list, syphilis is more often formative than destructive, osteomyelitis is both formative and destructive as are new growths.

The diagnostician must keep in mind that a lesion may posses the characteristics of two groups and that any lesion may show changes not characteristic, e. g., tuberculosis may be formative. In some cases diagnosis is impossible short of the microscope. However, x-ray plus clinical findings usually suffice for diagnoses.

Stereoscopy of the Accessory Sinuses. G. W. Grier, M. D. Am. J. Roentgenol. 10:497-500, June, 1923.

STEREOSCOPY of the accessory sinuses is urged as a routine procedure. The practical advantages are so great that a short trial will convince one that he cannot afford to omit the procedure. The technique is described and the author states that it is not difficult nor time consuming. Three minutes suffices for fitting the head to the head rest and for taking two sets of plates. The information yielded by this method is not procurable in any other way.

"The position which the tube shall occupy for the different exposures is determined by laying out the angles on a sheet of paper and then transfering them to a triangular sheet of aluminum with which the actual measuring on the patient is done. Since there is but comparatively little difference in the size of heads, it is practical to make sinus exposures with a fixed distance between the tube target and the plate. The procedure is easier if a small cone is used on the tube stand and the end of the cone brought a short distance from the back of the patient's head. With the tube in this position, the distance from the target to the plate is measured and this distance is used as the altitude in drawing a triangle, base up, which is to determine our angles. The base of this triangle is twice the distance between the pupils of the eyes, or four inches. The triangle so constructed is halved by bisecting the base line. We now have the three angles at which to make our exposures, represented by the sides of the two triangles, and as the middle angle is the stereoscopic distance, or two and one-half inches from either end, it will stereoscope with either

"This triangle is drawn full size on a piece of paper and the resulting angles are copied on an aluminum triangle which is fixed to the head rest or which may be used by placing it against the side of the patient's head in the usual way. One side of the aluminum triangle is so placed as to connect the external auditory meatus and the external canthus, the point of the triangle at the canthus, the base of the triangle extending toward the forehead. The altitude of this triangle then roughly outlines the base of the skull. The first exposure, or the one made at the greatest angle, is made at an angle of 30 degrees to the base line. This is easily done by tilting the tube so that a line drawn down lengthwise through the middle of the cone would be continuous with the line drawn on the aluminum triangle. The two succeeding exposures are made at the remaining angles in a similar manner.

"We thus get three good plates, any one of which is a perfectly good flat plate, the middle one stereoscoping with either one of the others, being the plate for the right eye with one and the plate for the left eye with the other. When viewed singly, the plate made at 30 degrees shows the frontals best, and the last one shows the maxillaries best. The middle one is made at about 25 degrees which is the universally accepted angle."

Pneumoperitoneal X-Ray Diagnosis. H. D. Mitchell, M. D., J. Am. Inst. Homeopathy, 15:705, Feb., 1923.

INTRAPERITONEAL injection of gas does not displace any of the present methods of diagnosis, but is used as an adjuvant to those methods now in vogue. Changes in contour, size, position or adhesions of the liver are most adapted to this procedure. The gall-bladder is often pictured. The spleen and the kidneys show readily, the tail of the pancreas often shows. Adhesions any place in the abdomen are well shown. Retroperitoneal glands or tumors can be shown. The question as to whether masses are above or below the diaphragm is easily answered. The uterus (normal or pathologic) can be shown, also the normal tubes and ovaries (as an indicator of the patency of the tubes it is apparently infallible), adhesions to the sigmoid and new growths which change the conformation of the uterus tubes or ovaries. Pregnancy can be differentiated from fibroids or neoplasms of the ovaries. Acute salphingitis is readily shown.

There are few contra-indications, but patients with definite heart lesions and dyspnea, those with acute diseases, e. g., salpingitis, temperature or status lymphaticus should not be examined by this method.

Carbon dioxide is preferred to oxygen because of its rapid absorption and consequent early relief of any distress which the inflation has caused.

The organ to be rayed must be surrounded by the gas and the patient must be manipulated to bring this about. The radioscopic technique does not differ from that employed in the examination of the abdomen by other methods, except that the exposures must be less.

The Furniss method for determining the patency of the tubes is advised.

—W. WARNER WATKINS, M. D.

Annular Shadows: Are They Cavities or Spontaneous Pneumothoraces? Philip King Brown, M. D., Am. J. Roentgenol. 10:445-453, June, 1923.

THE writer believes annular shadows can be proved to be lung cavities and believes that any lighter interpretation of them is a serious matter.

Many hundreds of such cases have been examined by him and while he admits that a localized pneumothorax *might* show as an annular shadow he has not met any such manifestation.

His reasos for this belief are as follows: (1) Antero-posterior and lateral views show these shadows to be equally round in all directions. (2) Artificial pneumothorax first compresses and then collapses these shadows and moves them from their original positions. (3) Pneumothoraces containing fluid will not empty, cavities will. (4) Stereograms have been taken by the author in 1/60 second, eliminating all motion and giving a detail never before secured in lung plates. These stereograms have shown the perspective of the shadows and their connection with the bronchi and how they increase in size by coalescing with adjacent and often with very small cavities.

If these four tests are applied the author contends that the manifestations will be found to be cavities and adds that in fairness to the patient these tests should be applied.

Diagnosis of Chest Lesions, Non-Tuberculous. A. Z. Ritzman, M. D., Pennsylvania J. Roentgenol. 4:20-25, July, 1923.

FOREIGN bodies opaque to roentgen rays are located by direct signs, those bodies not opaque to the rays are located by indirect signs.

In locating an opaque body if the small diameter is seen in the antero-posterior view the body is in the esophagus, if the large diameter is seen in this view then the body is in the trachea. If localization is still uncertain the patient should be turned partly to the left and a thick barium

mixture given. If the barium column is seen posterior to the foreign body or passing around it localization is complete and a radiograph will show the body in the trachea.

In locating a non-opaque body in the lungs or bronchi there are three characteristic signs to depend upon: (1) increased transparency over the entire affected side; (2) depression of the diaphragm on the affected side; (3) displacement of the heart and mediastinal structures away from the affected side. These signs are best seen at the end of expiration.

The normal pleura is not visible by x-rays and the pleural cavity is seen only when filled with fluid or air or both. The first radiographic symptom of pleurisy with effusion is a fixation of the diaphragm which may be detected before any fluid is seen. The quantity of fluid may vary greatly from a small amount in the costophrenic cavity to an amount sufficient to displace the heart and aorta. A thickened pleura or an unresolved pneumonia may be mistaken for fluid. Serum and pus cannot be differentiated.

Examination for lung abscess should be made with patient in the upright position and should never be made just after a severe paroxysm of coughing as the abscess may then be empty

Syphilis of the lungs is difficult to diagnose.

X-ray study of the heart has not reached a satisfactory stage. There are a great many factors to consider in this diagnosis and omission of any one of them may lead to a mistaken conclusion.

Pulmonary Tuberculosis as Shown by the X-Rays—Without Physical Signs. Stanley Melville, M. D., Arch. Radiol. & Electroth. 28:23-28, June, 1923.

THE author reports four cases of pulmonary tuberculosis, without physical signs, in which diagnosis was established by x-rays.

A recent statement in a book lately published by an eminant clinician and pathologist is to the effect that the x-ray does not detect tuberculosis in the absence of physical signs. This is contrary to the experience of the writer of this paper.

A Study of Lobar Pneumonia and Its Pulmonary Complications by Serial Roentgenographic Examination. L. R. Sante, M. D. Am. J. Roentgenol. 10:351-365, May, 1923.

OF the 272 cases of frank lobar pneumonia treated by this author during the last two years 152 were subjected to roentgenographic examination at three day intervals throughout the course of the disease and these findings were correlated with the clinical history and physical signs. The author's summary reads thus: "(1) Owing to the similarity in appearance, differentiation between the stages of active consolidation in lobar pneumonia is impossible from the roentgenogram. (2) In the majority of cases, lobar pneumonia starts as a consolidation in the hilus region, rapidly spreading peripherally, and involving an entire lobe. In a few cases in children, the onset of consolidation is cortical and progresses toward the hilus. (3) The shadow produced is homogeneous and is usually confined to one or more lobes. (4) During the stage of resolution the shadow becomes mottled and irregular, complete resolution being effected often in a very short time—three days. (5) The average time for resolution is seven to ten days after the crisis. Persistence of the shadow or failure of resolution after fourteen days is distinctly pathological, and suggests some complicating lesion. (6) The pulmonary complications most frequently encountered following pneumonia are: (a) Dry pleurisy, with thickening of the pleura. (b) Pleural effusion, either serous or purulent, and either general or local. (c) Plastic serofibrinous pleurisy. (d) Chronic interstitial pneumonia or fibrosis. (e) Lung abscess. (7) Their roentgenographic differentiation is indicated."

Sixteen illustrations accompany the text.

The X-Ray Picture of Interlobar Exudates and of Induration of the Pleura with Particular Attention to the Differential Diagnosis of Tuberculous Infiltrations in the Upper Right Lobe. P. Flemming-Moeller, M. D., Acta Radiologica, 2: 139-155, No. 6, May 1923.

CONTRARY to general opinion, the x-ray examination does not yield absolutely reliable proof upon which to base a diagnosis of interlobular exudate. The exudate gives a characteristic picture but the same picture is seen in pulmonary tuberculosis and in simple bronchopneumonia. Therefore the picture is not conclusive and must be taken in connection with the clinical history and physical findings. A test puncture is the only conclusive evidence.

However, a well defined lower border of shadow is more apt to indicate an infiltration than an exudate, and vice versa. Interlobular induration of the plura is prognostic of eventual pulmonary tuberculosis.

Pulmonic and Cardiac Changes Following Inoculation with Foreign Protein. I. Edward Liss, M. D., Am. J. Roentgenol. 10:435-437, June, 1923.

THIS investigation covered 33 cases of which 9 had been inoculated with typhoid vaccine, 16 with diphtheria antitoxin and 8 with influenza vaccine. The larger percentage showed definite pulmonary changes after injection of the foreign protein, a smaller percentage showed cardiac changes.

Investigations Regarding the Condition of the White Blood Corpuscles in Guinea Pigs and Rabbits Exposed to Irradiation with Visible Rays. Carl Sonne, M. D., Acta Radiologica, 2:116-127, No. 6, May, 1923.

THIS is a report from the Finsen Medical Light Institute in Copenhagen. It reviews the research along this line by other workers and presents the author's own studies.

His summary follows: "By irradiation of white shaved guinea pigs and rabbits with visible luminous rays a perceptible effect on the condition of the white blood corpuscles is proved. In guinea pigs an immediate decrease in the number both of lymphocytes and leukocytes occurs, but this is most pronounced for the former. Later when the irradiation has ceased, an increase in the number of lymphocytes occurs in the course of a few days, so that this number exceeds the normal for some time. Coincidentally the number of the polynuclear leukocytes seems to be, if anything, normal. These changes correspond to those found by Murphy and Sturm with regard to the temporary influence of dry heat on rats, mice, and guinea pigs.

"In rabbits, forty-five minutes after the irradiation, there is a very considerable increase in the number of polynuclear leukocytes, simultaneously with a generally somewhat smaller decrease in the number of the lymphocytes, so that the normal strongly pronounced lymphocytic form has in the course of two to three hours become leukocytic. Next day the form is again normal, so that it can once more be affected in the same manner by a new light-bath."

The Effects of Roentgen Rays and Radioactive Substances on Living Cells and Tissues. Leo Loeb, M. D., J. Cancer Research, 7:229-282, October, 1922.

THIS article treats of the subject under (1) sources of radiant energy within the body; (2) differences in the resistance to radiation of different

tissues in mammals; (3) effect of radiation on nucleus and cytoplasm; (4) effect of radiation on tumor cells; (5) quantitative graded effects of radiation upon tissues and tumors; (6) stimulating effects of radiation; (7) latent period; (8) relation between intensity and character of rays and their effects on cells and tissues; (9) phenomena of immunization after repeated radiation; (10) indirect effects of radiation on resistance and immunity; (11) toxemia after radiation; (12) comparison of the effects of radiating tissues in vitro and in the living organism.

The observations, studies and conclusions of many leading authorities are here discussed and are cemented into a whole by the author's knowledge of the subject. A bibliography of about one hundred articles accompanies the text.

A Critique of Tumor Resistance. William H. Woglom, M. D., J. Cancer Research, 7:283-299, October, 1922.

ORIGINAL observations from experimental study are recounted in this article. The author's conclusions read as follows: "Because the doctrine of resistance has proved so barren and so inconsistent, it is proposed that propagable tumors be investigated from another aspect, and the relation between a tumor and its blood-vessels is suggested as perhaps worthy of consideration.

"The question is raised whether the receding tumor may not differ from the growing one only in the extent to which its blood vessels have been obliterated by thombosis, and whether every growing tumor may not therefore be potentially a receding one."

The Regression of Spontaneous Mammary Carcinoma in the Mouse. William H. Woglom, M. D., J. Cancer Research, 7:379-394, October, 1922.

ABOUT 2000 mouse tumors furnished the basis for this study. Regression may take place by recession without any appreciable morphological alteration not to be distinguished microscopically from a growing neoplasm, or regression may take place by widespread necrosis, or complete keratinization.

No common histological feature has been found in receding carcinomata. Regression does not seem to be brought about by any constitutional alteration in the bearer as far as these studies show.

"The factor responsible for spontaneous cure appears to reside neither in the stroma nor in the parenchyma of the tumor though the latter cannot be entirely eliminated. By exclusion only the blood vessels remain, but it cannot be shown from the material here discussed that vascular changes underlie spontaneous cure."

The Present Cancer Problem in the United States. Frederick L. Hoffman, LL. D., Consulting Statistician, Prudential Insurance Company of America. The World's Health (Red Cross) 4:18, May, 1923.

THE writer states that the death rate from cancer in the continental United States is probably 90 per 100,000 and the annual mortality from cancer not much less than 100,000. This is an increase of 25,000 since the educational campaign against the disease was organized. This education, nevertheless, he believes will greatly aid in the control of cancer.

The true status of facts is at present largely a matter of conjecture as statistics are not properly kept and sometimes not kept at all.

Alleged cancer cures are gaining in popularity because many of them at first give relief. The disastrous results which follow call for an investigation of the whole subject of alleged cancer cures.

The rarity of cancer among pure native tribes the writer believes offers a field of study to investigators and might shed some light upon the cancer problem. The negative aspects of cancer study he believes have received too little attention.

Intrathoracic Changes Following Roentgen Treatment of Breast Carcinoma. T. A. Groover, M. D., A. C. Christie, M. D., and E. A. Merritt, M. D., Am. J. Roentgenol. 10:470-476, June, 1923.

THE authors believe that large doses of roentgen rays delivered to the deep structures by means of prolonged treatment through a copper filter bring about changes in the pleura and often in the lungs. These changes are analogous to those produced in the skin and the symptoms of intrathoracic irritation closely follow the course of the skin reaction.

Observations are based upon clinical and roentgen findings and are not offered as definite proof that the rays are responsible, but that is the author's belief.

Breast Carcinoma Treated Surgically and by Roentgen Ray. Cassie B. Rose, M. D., J. A. M. A. 80: 1750-54, June 16, 1923.

THE two cases here reported with clinical and postmortem findings, are submitted as contributions to the study of roentgen ray therapy. Similar cases have been presented by others but without necropsy reports.

The clinical pictures were much the same in each, both were carcinomas of the breast, the first case had had three operations, the last one was followed by roentgen ray treatment. The second case had had two operations, the last one followed by palliative roentgen ray treatment.

Postmortem of the first case showed a large pleural effusion without pleural thickening in the right chest at the site of the tumor and where the greatest amount of x-ray had been received, but no carcinoma was present. No inflammatory process of the pleura was present but there were two small tuberculous foci in the apex of the right lung. The writer believes that the rays lowered the patient's resistance to tuberculosis and stimulated the effusion.

The second case, upon postmortem, showed pleural thickenings and a large pleural effusion of the left side of the chest (site of the second tumor and of greatest amount of roentgen ray treatment) which may have been accounted for by the numerous carcinomatous nodules found in the pleura. Central necrosis in the small nodules "speaks strongly for the destructive action of roentgen rays on carcinoma cells * * * abundant stroma surrounding the tumor nodules, and the marked fibrous thickening of the pleura, speak for the stimulation of fibrous tissue by the roentgen rays * * *"

Pernicious Aplastic Anemia. Knud Faber, M. D., Acta Radiologica, 2:110-115, No. 6, May, 1923.

THIS is a case report from the medical clinic of the University of Copenhagen and it reports the case of Dr. Nordentoft who after many years practice in radiology fell a victim to pernicious aplastic anemia.

The first symptoms were noticed many years ago but did not become very alarming until the latter part of 1921. Arsenic and iron, also intravenous injections or protein, were used but without success.

A similar kind of anemia has been observed in two other radiologists and in three x-ray technicians and the writer does not doubt that it was caused by the effect of the hard rays.

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Further Studies in Radiation Dosage*

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IN THE introduction to a monograph by the late Theodore Christen on the measurement and dosage of roentgen rays, published in 1913, it is stated in the opening paragraph that the great need in radiotherapy is the means of accurate dosage. Though the theories which Dr. Christen advanced in his book have been nearly forgotten, so rapid is the progress in our art, the words of the opening sentence are still as true as they were some ten years ago.

For some radiographers are still treating internal cancer with 10 or 15 minute exposures with a filter of 3 mm. aluminum and an 8-inch gap, but without the slightest idea of the erythema dose of their machine or any comprehension of the quantity or the effect of the radiation which is penetrating the deeper tissues. If they accomplish anything they stimulate the tumor rather than inhibit its growth.

But, on the other hand, there are fortunately many capable men who are studying by the most refined scientific methods the problem of applying to the tumor tissue a dose which will inhibit the growth rate of the neoplasm, even if it does not necessarily effect a permanent cure.

As a contribution to the subject which may interest the latter group, I want to present some of the recent studies which have been carried on in the Crocker Institute of Cancer Research, using animal tumors as an indicator.

These experiments were made in all cases with a commercial machine running at 170,000 volts. This voltage was very carefully determined by a physicist using a 25 cm. sphere spark gap and the standard potential tables for an instrument of these dimensions. The results were cross checked with a static volt meter which had been calibrated by the use of a 20 megohm resistance. The wave form of the machine is shown in Figure 1. It is fairly flat topped and below it is the current curve showing that the voltage and the current are in phase. The rectifying switch had been carefully set by determining with an ionization chamber the maximum output of x-rays, the only variable in the test being the position of the switch on its axle.

Repeated determinations of human erythema doses with the apparatus thus adjusted have shown that, on the average, 45 minutes with a 40 cm. skin-focus distance, 5 ma. through the tube, ½ mm. of zinc plus 1 mm. aluminum filter, will give a dose which is just short of an erythema. Forty-eight minutes is a good erythema on sensitive skins, and 50 minutes gives a fairly sharp reaction in ten days on insensitive skins.

The death point of the tumor which we have used as a standard (Crocker Fund Tumor No. 180) was found to be 250 minutes under these conditions, that is five erythema doses. The conditions of the experiment were such that all scatter was eliminated, the tumor being supported upon thin gauze at some distance from any substance which might give secondary rays.

Assuming, therefore, that the tumor is killed without scattering with 5 erythema doses, it is interesting to observe what happens when some substance whose absorption capacity corresponds approximately to that of human tissue is used between the tumor and the x-ray tube (Fig. 2).

Under these circumstances employing a block of paraffin wax 10 cm. thick at a distance of 10 cm. above the tumor with a 10 by 10 cm. field, the dose required to kill all the tumor cells was, instead of 250 minutes, 675 minutes. This shows that such a thickness of paraffin absorbs 63 per cent, in other words, only 37 per cent of the x-ray reaches the tumor placed 40 cm. from the anticathode. This may be called a pure absorption experiment. Such conditions do not apply in human therapy, as the tumor is always in contact on one or both sides with substances of low atomic weight which gives a large amount of scattered radiation. A superficial tumor receives a scattered dose only from the tissue under it. To determine the dose under these circumstances the tumor tissue was placed in a tube of celluloid on a layer of water or wax at a distance of 40 cm. from the anticathode and exposed. Instead of being five erythema doses the quantity necessary to kill all the cells of the tumor fell to about four erythema doses (Fig. 3).

As the tumor particles are not thicker than one mm. and are laid out in a plane, the inverse square relations and absorption factors in regard to tissue thickness can be disregarded. Thus, this particular tumor is some three and a half to four times as resistant as a human basal-cell carcinoma, which, as is well known, if it does not happen to contain pearls can usually be cured with a full erythema dose.

When the tumor tissue was placed between two blocks of paraffin, 10 cm. thick, the rays were allowed to strike the tumor material through a 10 by 10 cm. opening, the skin focal distance being 30 cm. and the distance to the tissue 40 cm., the dose was 360 minutes instead of 675, thus showing how important a factor the scatter is even through a comparatively small opening; nearly one-half of the effect being due to the scatter (Fig. 4). Inasmuch as the skin focal distance was only 30 cm. the erythema dose is much shorter, about 28 minutes, consequently the skin received slightly less than 20 erythema doses. This is a very unfavorable situation, practically because such dosage is impossible in man.

If on the other hand the lead opening was increased to 18 by 18 cm. all the conditions remaining the same, all the tumor cells were killed at 240 minutes exposure or 8.5 erythema doses to the skin (Fig. 5). This still is an unfavorable working condition, as it means approximately light portals. If, however, the skin-focus distance is changed, as it was in another series, to 40 cm. instead of 30, the tumor then being 50 cm. from the anticathode we get a

*—Read at the Annual Meeting of the Radiological Society of North America, Dec. 7, 1922.

death point of all the cells in 320 minutes, which is at that distance 6.4 erythema doses on the skin.

Nothing was varied in these last three experiments except the area of the portal and the skin-focal distance. Thus we get biological confirmation of what has been preached by Dessauer for many years, that from a purely physical point of view a much better depth effect is obtained by using a longer skin-focus distance. These experiments show that we are reaching a point even at 170,000 volts where we may theoretically assume we can kill all the cells in a tumor.

Whether this can be accomplished in practice must wait the clinical application of such facts as I have shown. Much remains to be done. We have not yet accurate data concerning normal tissue resistance, for example, whether human intestine or other hollow viscera will stand four erythema doses. Will the large portals which are necessary permit so great a destruction of normal tissue that the phenomena designated as radiation sickness necessarily interfere with our treatment? This, in my experience, has been a very serious matter with a number of patients who have practically refused treatment after a few exposures to an erythema dose, even though they realize that the radiation is controlling an abdominal tumor. We have not yet given more than four erythema doses at a sitting to a deep seated tumor, that is just two thirds the amount required to kill this mouse tumor No. 180. In several of these patients radiation sickness was not evident but unfortunately also there was not the slightest change as far as could be made out in clinical examination of the tumor, which was in four instances inoperable carcinoma of the cervix.

We can reason, therefore, that the tumors in these patients were as resistant as a mouse tumor, for with even two erythema doses on a mouse tumor it is possible to kill a very large percentage of the cells composing the tumor and greatly to reduce its size.

I hope that on another occasion I will be able to report to you the continuation of these studies using, what is evidently necessary, higher voltages in order to get a better depth effect and also report some of the very interesting observations which we have been able to make on x-rays derived from a continuous current of high voltage.

It seems to me that the possibility of the cure of cancer from a point of view of apparatus alone depends upon our ability to obtain a tube which has a reasonable life at 250,000 volts with a capacity to carry a considerably larger quantity of current than at present.

If these conditions can be complied with, as the physicists have shown, a very much better depth dose can be obtained and we are possibly within striking distance of a cure. But I still believe, as I stated years ago, that a permanent cure of cancer means the direct destruction of every living cancer cell and that no help can be expected from the normal or irradiated tissues in which the cancer cells lie.

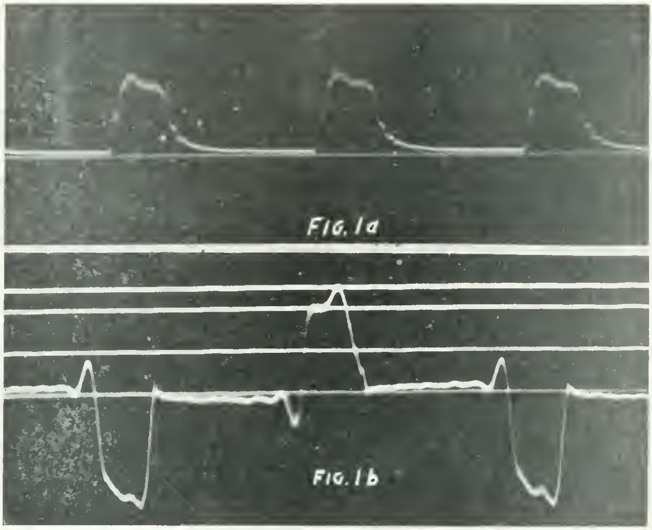

Fig. 1—**A**, oscillograph tracing of voltage. **B**, oscillograph tracing of current [illegible]

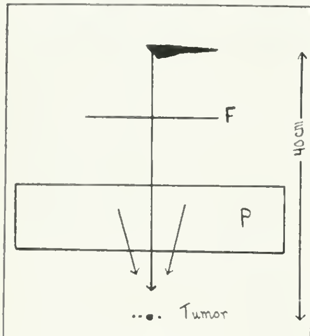

FIG. 2

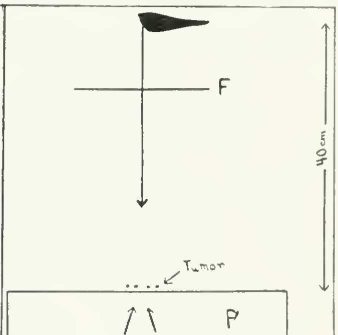

FIG. 3

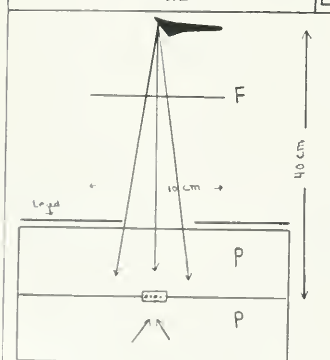

FIG. 4

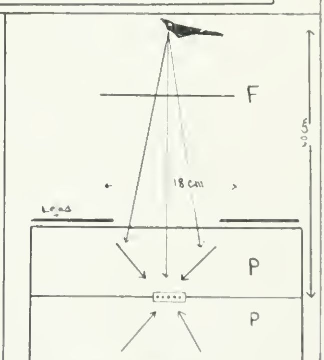

FIG. 5

Bone Tumors, Benign Bone Cysts Due to Central Ostitis Fibrosa of the Unhealed Latent Type.

With Discussion of the Operative Treatment, Especially the Crushing of the Cyst Wall*

JOSEPH COLT BLOODGOOD, M. D.
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IN THIS series of papers, written specially for this journal, I have endeavored as far as possible to deal with problems of diagnosis and treatment based upon the more recent observations and to write as briefly as possible, presenting the subject from the practical clinical side.

Etiology of Ostitis Fibrosa

Interesting as this is, at the present time, we do not know the cause of this lesion and we can outline no preventive treatment. Clinically, it is a benign lesion; pathologically, it is a form of chronic inflammation.

Biologically, its entire tendency is to spontaneous healing with restoration of the affected portion of the bone to normal. This is the biological history of practically all inflammatory processes: *First*, a reaction of the tissues to some known or unknown irritating factor; *second*, the production of a new tissue which may be called granulation tissue completely or partially replacing the normal tissue; *third*, the disappearance of this granulation tissue, its replacement by normal tissue with more or less residual scar tissue.

The duration of the process of new formation of granulation tissue and its reabsorption varies. The completeness of restitution to normal varies.

Clinical Picture First Type of Bone Cysts

The most striking fact in my personal study of now more than 100 bone cysts is that the majority can be placed in a single group in which the prominent clinical facts are: (1) The age of the patient is under eighteen, usually under fifteen; (2) a fracture of a long pipe bone after a slight trauma to the shaft; (3) an immediate x-ray demonstrates the disappearance of the normal picture of the marrow and cancellous bone, the presence of a thin shell of cortical bone which usually shows slight expansion, a fracture through some portion of this thin bone shell; (4) the degree of fracture varies from a line of destructed continuity in the thin bone shell up to extreme degrees of comminution. The former is common, the latter rare.

The situation of this bone cyst with the rarest exceptions is in the shaft and not in the epiphysis, and, although we must conclude that the bone lesion was present before the fracture there is no evidence in the x-ray of new periosteal bone formation on the cortical bone forming the bone shell.

The next most remarkable fact in this group is that if no operation is performed and the fracture is treated as any other fracture, healing with complete ossification and restitution to normal takes place almost as rapidly as after a fracture in a normal shaft.

This is a very important and practical knowledge and it leads to a definite line of treatment. In cases of this kind the treatment should be non-operative and identical with that for a fracture of a normal bone, except that in these patients x-ray pictures should be taken at more frequent intervals in order to demonstrate that ossification is proceeding normally not only in the line of fracture, but throughout the entire shadow of the cyst.

In a certain percentage of these cases the complete ossification of the area of the bone cyst shown in the x-ray is very much slower than in the normal bone. Especially is this true when the fracture is slight, incomplete or not comminuted. Therefore it is of great importance to be familiar with the usual healing of a bone cyst with the different degrees of fracture, so that one may conclude when operative interference is indicated, and to remember that when an operation is performed the most important thing to do is to produce some form of fracture or crushing of the bone shell.

Average Duration of Healing in The Common Type of Bone Cysts

I have for study here two groups: One in which no operation was performed, and the second, in which an operation was performed. The healing of the bone cyst in which there has been a fracture of very slight degree is usually not complete for two to four years. If accidental refracture takes place the rapidity of healing is increased. If the fracture is comminuted, complete ossification is as rapid as in the normal bone. The rapidity, therefore, of complete ossification in the ordinary bone cyst after fracture is largely influenced by the extent of the fracture. In a certain number of these cases operation has been performed. In the vast majority of cases the indication for operation was exploration for diagnosis. The healing in this group has been about identical with that in the first group, unless at the operation the extent of the fracture was increased, or the bone shell comminuted. In the first case operated on by me in 1903, in which the cyst occupied about one half of the upper portion of the humerus, the fracture was slight, transverse without displacement. The operation consisted in the removal of a small piece of the shell and letting out the fluid. There was no connective-tissue lining. At the end of one year the cyst was two-thirds smaller; at the end of seven years the humerus was restored to normal. In a second case, practically identical with the former, x-rays were taken at frequent intervals and complete ossification was not observed until the end of the third year. In a third case in which the cyst was much larger and situated in the tibia, I crushed the thin bone shell. Here complete ossification took place in three months.

There are numerous other observations which lead to the practical and definite conclusion that the best treatment for a bone cyst is a comminuted fracture. If ossification is not rapid after the first fracture much time will be saved by an operation.

Clinical Picture of the Second Type of Bone Cyst

Here there is no fracture. The presence of a cyst is found either accidentally because of an x-ray examination after an ordinary trauma, or because of pain and swelling. The size of the cyst varies. When these cases are studied with numerous x-ray pictures, we find that ossification is very slow. In the first case, observed by Colvin of St. Paul, in which the cyst was situated in the upper end of the ulna, it was seven years before complete ossification took place. This patient has now remained well more than fifteen years. I have an x-ray of a cyst in the upper third of the shaft of the femur in a boy aged nine years, which was revealed because the patient limped. We followed the cyst in the x-rays for three years: there was very little ossification. The patient, however, had no other symptoms but a slight limp. Operation was decided upon, but the boy fell, sustained a comminuted fracture in the region of the cyst and complete ossification took place in six weeks. This bone is prac-

*—Received for publication May 5th, 1923 (Reprint No. 122).

tically restored to normal now more than six years since the fracture.

Without going into the details of the other observations, the evidence favors the following conclusions:

When an x-ray shows a bone cyst without fracture, and subsequent x-ray examinations demonstrate slow or imperfect ossification, operation is indicated. The chief danger of not operating upon a bone cyst which is not ossifying is that it may reach great size and convert a simple operation into a difficult and sometimes dangerous one.

In addition, it is more difficult in the big bone cyst to restore the continuity of the bone to normal; there are very apt to be bending deformities very difficult to correct.

Clinical Picture of the Third Type of Bone Cysts

In this group the patient's age is over fifteen, and for this reason other types of central bone lesions cannot be excluded. If it is associated with a fracture of some extent, there seems to be no danger from the postponement of the operation which will be avoided if complete ossification is observed in the x-rays. But in the absence of fracture or if ossification is tardy or does not occur, operation is indicated. If a bone cyst is revealed nothing has been lost; if the tumor proves to be a benign giant-cell growth, or a chondroma, myxoma or sarcoma, no time has been lost in instituting the proper operative treatment.

The Crushing of the Bone Shell in the Operation for Benign Bone Cysts

This is best illustrated by the report in detail of the following case:

Case I. (Pathol. No. 32392, Figs. 1, 2 and 3): Benign bone cyst of upper end of femur involving the trochanteric area and neck. Patient, a white female aged 27; definite symptoms fifteen years, since the age of 12. Operation: removal of connective-tissue lining, filling the cavity with pieces of bone and crushing of the anterior shell.

Clinical Picture: This patient, Miss S., was referred to me by Dr. Abraham Shorr of Brooklyn, N. Y. The patient was aged 27, unmarried. She has been conscious of pain in the region of the left trochanter since she was 12 years of age, fifteen years ago. The pain is worse after walking, and after prolonged walking there is a limp. The pain and limp have gradually increased. Six months ago she began to use crutches and then, later, a Thomas's splint without crutches. The first x-ray, taken in June 1922, is practically identical with the one taken by Dr. Kahn in my office in April 1923. The patient does not remember how long she has been conscious of a swelling in the region of the left trochanter, or how long there has been apparent shortening of slight degree. There has been no evident restriction of motion in the hip-joint.

Etiological Factor: The patient distinctly remembers that she was knocked down by a bicycle before she felt pain and before limping began fifteen years ago.

Examination: All laboratory studies are negative. The x-ray and physical examination of the chest are negative; there are no evident foci of infection in tonsils, teeth or sinuses. The patient appears in perfect health, slightly overweight. Her recent occupation has been that of a teacher. The x-ray pictures of all the bones, except the upper end of the femur, show normal bone. The patient walks with a slight limp. When lying on her back there is an apparent shortening of about one centimeter and about an equal measured shortening. The outer lateral surface of the left thigh in the region of the great trochanter shows more of a bulging than the right. On palpation the left trochanter is larger than the right. There is no restricted motion in the hip-joint.

X-ray Study: The x-ray pictures (Figs. 1 and 2) were taken by Dr. Kahn, April 5, 1923.

When we compare the left upper end of the femur with the right, the pelvis and acetabular cavity seem identical. The width of the head in the acetabular cavity is identical; the shape and size of the heads of the femora are identical, but projecting from the neck of the left femur into the head is the definite shadow of a cyst with a thin definite bone shell, as if the neck had been broken and wedged into the head. (At operation we could trace the cyst into the head of the femur).

The outline of the left neck is entirely different from normal. Instead of two curved lines with the concavities towards the neck, the outline of the left neck is practically two straight lines between the head and the trochanter. The shape of the neck is that of a blunt wedge. The measurements of the normal neck at its base on the intertrochanteric line is 6 cm., on the affected side almost 8 cm. The bone shell of the cyst in the neck is intact, and we can follow this narrow shadow of the cortical bone of the neck into the head of the femur. The intertrochanteric line is partially obliterated. The greater trochanter is expanded, and the curve beneath the trochanter showing normal on the right side is changed from a convexity to a concavity on the left side and we can trace the cyst extending down into the upper shaft of the femur. The lesser trochanter is smaller on the affected

Fig. 1.—Pathol. No. 32392. Case I. Bone cyst of upper end of femur, involving trochanter and neck. Compare the affected (left) with the upper end of the right femur.

Fig. 2.—Pathol. No. 32392. Case I. Bone cyst of upper end of the femur, involving neck and trochanter. Age 27, symptoms 15 years.

Fig. 3.—Pathol. No. 32392. Case I. Bone cyst of upper end of the femur, involving trochanter and neck. X-ray 12 days after crushing of the bone shell and filling it with fragments of bone.

Fig. 4.—Pathol. No. 13831. Case II. X-ray of benign bone cyst of upper end of the tibia. No fracture. White boy aged 16, uniform swelling two and one half years.

left side due to the expansion of the neck; there is a line of incomplete fracture in the upper end of the shaft, although there has been no history of fracture. The actual length of the neck of the femur on the left side between head and lesser trochanter is one centimeter longer. This lengthening of the bone is unusual in bone cysts, but it has been observed before. The shaft of the femur at a point just below the lesser trochanter bends inward producing an adduction deformity. The left trochanter is on the level with the upper rim of the left acetabular cavity, while the right is 2.5 cm. below it. This can be explained by the expansion of the trochanter.

It is very interesting to note that the x-ray absolutely outlines the bone cavity found at the operation.

Diagnosis: The age of onset at 12, was the chief evidence of a bone cyst. The long duration of the symptoms, fifteen years, excluded a sarcoma, but there is nothing in the x-ray picture to exclude a giant-cell tumor, myxoma, chondroma, multiple myeloma or metastatic hypernephroma. The giant-cell tumor rarely gives as long a history, but the chondroma and myxoma do.

Indications for Operation: Although the age of onset, twelve years, and the duration of definite symptoms, fifteen years, indicated a benign bone cyst, nevertheless the other types of central lesions, except sarcoma, had to be borne in mind. If the lesion was a bone cyst, operation was indicated, because after fifteen years it was still unossified and was already beginning to show bending deformity. Further delay would run the risk of further deformity and a larger bone cyst. Fortunately there was no interference with joint function, and the head of the bone and acetabular cavity were still intact.

X-ray or Radium Treatment: X-ray treatment had been given during the past summer without effect, and from my experience as already recorded in previous communications, operation promised more than any other type of treatment.

Plan of Operation: First, diagnosis. If the tumor should prove to be a bone cyst, no thermal or chemical cauterization would be necessary. The object of the operation would be to get ossification in the cystic area. If a giant-cell tumor, myxoma or chondroma were revealed, the object of the operation would be to get rid of the disease by thermal and chemical cauterization, or resection of the upper end of the femur with bone transplantation. The decision would rest upon the strength of the bone shell after eradicating the disease.

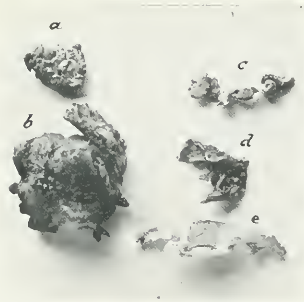

Fig. 5—Pathol. No. 13831. Case II. Photograph of the thin bone shell and connective-tissue lining from the benign bone cyst shown in Figure 4: **a**, connective-tissue lining, surface covered with fine calcium deposits; **b**, surface of connective-tissue lining adjacent to the bone shell covered with fine sand-like spicules of bone; **c** and **d**, thinner portion of the connective-tissue lining; **e**, thin bone shell showing two perforations; the periosteum was intact over these perforations.

If the tumor should prove to be a bone cyst, I considered the question whether any attempt should be made to produce a fracture below the lesser trochanter in order to correct the adduction deformity. If you will glance at the x-ray picture you will observe that the thickness of the cortical bone of the bone shell is greatest on the inferior side of the neck and the medial side of the shaft. This was bearing the weight at that time. I felt that it would be safer to get ossification in the area of the bone cyst without fracturing this, the strongest, part. The function of the patient's limb was still good; the shortening was not enough to justify the risk of its correction. The object of the operation was to so strengthen the bone that there would be no further deformity.

Operation: St. Agnes Hospital, April 27, 1923. Anesthesia: novocain in the skin, gas, some ether. On exposing the upper end of the femur through an external lateral incision I was struck with the tenseness of the fascia lata and the relaxation of the fascia of the quadriceps femoris. We could feel the expansion of the trochanter and the obliteration of the curve of the shaft below, but we could get no yielding to pressure in the bone shell. On stripping back the periosteum, there was no excessive bleeding and the bone surface appeared normal. Usually in the bone cyst the bone shell is thin and has a dark gray appearance. The area of exposed bone on the external lateral surface of the femur from the top of the great trochanter down to the line of the apparent fracture, a distance of 8 cm.,

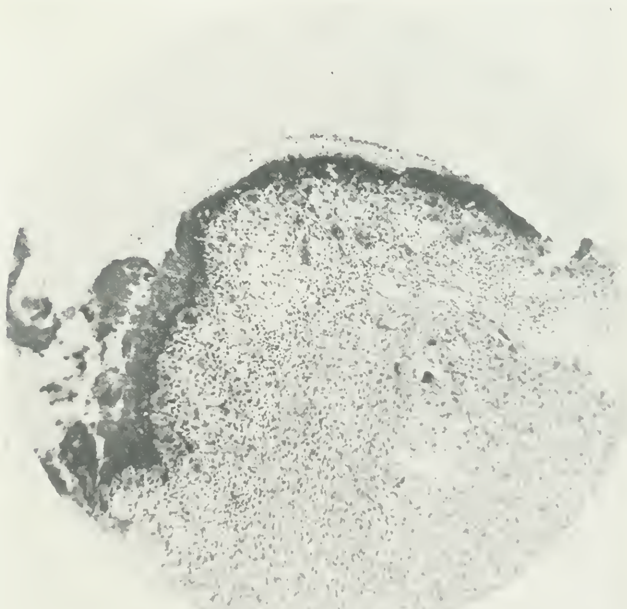

Fig. 6—Pathol. No. 13831. Case II. Photomicrograph of ostitis fibrosa in piece of connective-tissue lining shown in Figure 5-a. On the upper surface is shown a thin zone of calcium deposit; then a zone of vascular granulation tissue with giant cells; then a zone of cellular granulation tissue with less blood vessels and here and there a giant cell.

was chiselled off. This at once exposed a cavity in the great trochanter, in the neck, and in the upper outer portion of the shaft below the great trochanter, but the medial portion of the shaft below the lesser trochanter was filled with bone, and the marrow cavity was obliterated, as shown in the x-ray. The surface appearance of the bone shell was remarkable. Those parts having no connective-tissue lining were smooth and dead white; other parts contained a connective-tissue lining varying from 3 to 8 mm. in thickness. Here and there in the connective-tissue lining were areas of bone formation. The cyst was filled with a clear viscid fluid. We had the gross picture of a benign bone cyst based upon the clear fluid and the leathery connective-tissue lining. There was every evidence that that portion of the bone cyst in the upper third of the femur on the medial side below the lesser trochanter had ossified

After removing the connective-tissue lining I took most of the piece of bone first removed and placed it in the cavity of the neck. I then chiselled particles of bone off the shaft until the cavity of the neck was partially filled. Then with the chisel I comminuted the bone shell of the great trochanter and of the superior and lateral surfaces of the neck, leaving intact the shell of the inferior portion of the neck. With a chisel and a piece of gauze I hammered together this broken bone until it formed a compact mass filling the neck and involved portion of the shaft. I then sutured the relaxed fascia of the quadriceps in such a way that muscle was inverted and packed against the mass of bone particles. This was done to insure better circulation. The wound was closed in layers with catgut.

Figure 3 (Pathol. No. 32392) is an x-ray of the result 12 days after operation.

Remarks on Case I (Pathol. No. 32392): The localization in the neck of the femur is unusual. I will summarize later my experience up to date with cysts in the upper end of the femur. Up to the present time this one is the largest, of longest duration and the only one upon which I operated personally. I look upon this as an example of unhealed bone cyst. From the thinness of the bone shell found at operation it is remarkable there has been no fracture. The only evidence of ossification, as stated before, was in the portion of the bone cyst in the upper part of the shaft at the level of the lesser trochanter. I have described the bone shell. The remarkable feature was its smoothness on the inner side, no evidence of new bone formation when the periosteum was stripped from the outer side; practically no bleeding when the connective-tissue lining was removed.

Case 2. (Pathol. No. 13831): The result after crushing of the bone shell in a large cyst of the upper end of hte tibia is here given.

I operated on this patient in Milwaukee in March 1913, nine years ago, with the late Dr. Charles H. Lemcn of Milwaukee.

Brief Summary: White boy, aged 16. Uniform swelling and expansion of the upper end of the tibia, beginning after contusion from a base ball. Operation: Removal of the connective-tissue lining, crushing of the bone shell; rapid ossification; Figures 7 and 8 are x-rays of result (1920) seven years after operation.

Clinical Note: Figure 4 (Pathol. No. 13831) is the x-ray taken just before operation. There is considerable expansion of the upper end of the tibia. The bone shell is thin. The upper portion of the bone cyst extends to within one centimeter of the epiphseal line and shows a fine line of ossification. Below the lower portion of the light shadow of the cyst there is a wide zone of ossification filling the marrow cavity.

This is an example of a bone cyst with fracture. First attention was called to it by swelling of the upper third of the tibia. There was practically no pain. The boy remembered that three years before operation the involved area was struck with a base ball, but it was six or eight months before any swelling was observed. The swelling has gradually increased without pain and interference with function. The diagnosis of benign bone cyst was made from the history and x-ray at that time.

Operation: The incision exposing the bone shell was made without an Esmarch. The veins over the periosteum were unusually dilated. Up to that time I had only observed such dilation of the veins when the lesion has been a giant-cell tumor. Now I know that it is frequently present in the large bone cysts. However, it was not observed in Case I here described. The

Figs. 7 and 8.—Pathol. No. [illegible] Case II. [illegible] perfect result in 1920, [illegible] after operation.

Fig. 9.—Pathol. No. [illegible] Case III. X-ray, anteroposterior [illegible] of the shaft of the femur. Patient [illegible] Patient of Dr. Prince of Rochester, N. Y. [illegible] suggested an osteochrondroma or [illegible]

Fig. 10.—Pathol. No. 20209. Case III. Huge bone cyst of shaft of femur. Lateral view of the case shown in Figure 9

shell of bone was dark like the bark of a tree and so thin that it gave parchment crepitation. On stripping back the periosteum there was no new bone formation. We could observe in the bone shell numerous minute perforations (See Fig. 5-e). On removing a piece of the bone shell, there exuded a rather thick, yellow fluid. Later we found that this was due to the presence of calcium in the fluid. The cavity of this bone cyst presented an appearance which I have never seen before or since. The surface of the connective-tissue lining was covered with a fine granular dust like fresh snow (See Fig. 5-a). This deposit could be scraped off with the knife and left a smooth red surface like the mucous membrane of the mouth. In removing the connective-tissue lining which varied in thickness (See Fig. 5) there were sand-like particles of bone between the connective-tissue lining and the bone shell, and above and below the bone cyst the marrow cavity was filled with new bone. The connective-tissue lining was leathery in consistency. In removing the connective-tissue lining there was some bleeding, and one small artery torn across spurted and was clamped and tied with a fine bit of silk. Therefore, in Case 2 the vascularity of the bone shell and its lining was much greater than in Case 1. All the connective-tissue lining was removed, but the new bone formation above and below was not disturbed.

Obliteration of the Bone Cavity: The cavity shown in the x-ray (Fig. 4) would have easily held two large hen's eggs. There were three methods of filling this cavity—fluid, blood clot or salt solution which is successful in small cavities; transplantation of bone; or crushing of the bone shell.

Fortunately I had recently read of the crushing of the bone shell, and this seemed easier than bone transplantation. There was no difficulty whatever in comminuting the shell, and now the tibia was fractured and could be moved in any direction. The crushed bone did not completely fill the cavity. The interspaces between the bone were filled with blood clot. The wound was closed without drainage and healed per primam. The gross and microscopic pathology of the connective-tissue lining, ostitis fibrosa, is shown in Figures 5 and 6.

Healing of the Fracture in Case 2 After Crushing of the Shell: Dr. Lemon wrote me that complete ossification took place in about the same time as an ordinary fracture of tibia would take. Within a few months the boy was walking without crutches or a dressing, riding a bicycle and playing base ball. The early x-rays taken after operation were not sent me, but Drs. Lemon and Eugene A. Smith who took the x-rays reported rapid and almost complete ossification.

X-ray December 1920: (Figs. 7 and 8). These two views were taken about six and one-half years after operation and it will be observed that there is very little expansion of the area affected by the cyst when compared with Figure 4, but the marrow shadow is not restored to normal; there is apparently some sclerosis. The dark areas in the soft parts are either artifacts, or represent misplaced periosteum which has formed little islands of bone.

Result (1923): Ten years well.

Remarks on Case 2: This observation illustrates the rapid ossification after the crushing of the bone shell. It also shows that the normal architecture of the bone has not been restored absolutely. We do not know the duration of this cyst. it may or may not have been present since the trauma. We do know that it was getting larger, and the chances are that if it had not been operated on, it either would have remained latent without increasing in size, or have grown larger into the group of huge bone cysts which up to the present time with one exception have had to be subjected to amputation.

Huge Bone Cysts

This group is relatively small and, as before the advent of the x-rays bone cysts were relatively rare but now are relatively frequent, we have additional evidence that the tendency of the bone cyst is toward spontaneous ossification.

In an unpublished pamphlet which I wrote in April 1903 for teaching surgical pathology, I find this statement after bone cysts: "These are rare tumors. We have observed no cases, except a dentigerous cyst in the lower jaw." When I wrote this pamphlet in 1903, Dr. Halsted's clinic in Johns Hopkins had been open thirteen years. There had been 14,000 surgical cases, 40,000 patients in the hospital, and 62 examples of primary bone tumors. At that time I had reviewed the literature on bone cysts, (*Progressive Medicine*, December

Fig. 11—Pathol. No. 20209. Case III. X ray of result in the case of big bone cyst shown in Figures 9 and 10 seven years after operation, in which the fluid was evacuated, but the bone shell not crushed. Apparently the cyst shows ossification, but not complete. Dr. Prince reports good function in 1923.

Fig. 12—Pathol. No. 32199. Case IV. X-ray taken of bone cyst of upper end of femur involving trochanter, taken April, 1921. Boy aged thirteen years; duration of symptoms not given; no pathologic fracture. For result after noninterference see Figure 13.

Fig. 13—Pathol. No. 32199. Case IV. X-ray one year and nine months after the x-ray shown in Figure 12. This illustrates how rapidly a bone cyst may grow.

1899, page 235, and again in December 1902).

In the *Annals of Surgery* for August 1910, seven years later, I was able to review 89 cases classified as bone cysts. Many of these were from the literature. The first case observed and operated upon by me was in 1903, after the first pamphlet was written. All of the examples of large bone cysts are described and illustrated in the *Annals of Surgery*, and it seems unnecessary to reproduce the pictures here, or to go into the details of their history.

It is important, however, to again refer to the fact that two of them in which the huge cyst occupied the lower end of the femur, were subjected to a partial subperiosteal removal. In both instances the hemorrhage was profuse, in one the patient's life was saved by immediate amputation, the other patient died of hemorrhage without amputation.

The other two cases are autopsy specimens sent me by the late Dr. Roswell Park, from his museum.

In the *Journal of Radiology* for March 1920 I illustrated two further examples of huge bone cysts.

Figure 13 (Pathol. No. 20646) shows a huge bone cyst of the lower end of the femur. In this case a diagnosis of sarcoma was made and a hip-joint amputation performed in 1914. This patient is well in 1923, seven years later.

Figure 14 (Pathol. No. 20209) shows a very large cyst of the shaft of the femur which will be reported

Fig. 14 -Pathol. No. 32153. Case V. X-ray of a huge bone cyst of thirty-eight years' duration. Patient of Dr. R. B Morris, Olean, N. Y. There is almost complete ossification; the joint is ankylosed.

here in detail, because amputation was not performed, and we have been able to follow the partial healing of the cyst after an operation consisting of evacuation of the fluid only.

CASE 3. (Pathol. No. 20209): Huge bone cyst of the shaft of the femur. This patient was a white female, aged 18. She spoke very little English. The swelling had been present one year, since an injury. There had been little or no pain, and very little loss of function.

X-ray Study: Figures 9 and 10 show the two views of this unusual tumor. In Figure 9, the antero-posterior view, we see the shaft of the femur surrounded by a shadow of bone formation. In the center of the shaft of the femur there is a light area. The outer outline of the periosteal growth does not show a smooth unbroken bone shell. I had never seen a bone cyst with the outline of the shaft preserved as in this case. The picture suggested an osteochondroma. In the lateral view we can observe that the shaft of the femur is involved, and it shows cavity formation, which would not be expected in a periosteal osteochondroma. On palpation one could feel a distinct bone shell beneath the muscles.

Operation: September 6, 1916, Rochester Clinic, N. Y. with Dr. H. L. Prince. Knowing the danger from hemorrhage if there is much subperiosteal exposure of the bone shell in these large cysts, I made a small incision through skin, fat and muscle fascia, and stripped back the periosteum. The bone shell was dark in color, but even from this small exposure there was a good deal of oozing of blood. On removing a small piece of the shell the bone cavity contained a slightly blood-stained serum under no pressure. Having excluded a giant-cell tumor and any other type of bone tumor requiring a radical operation, nothing more was done.

Microscopic Section: The Haversian canals of the piece of bone removed are filled with tissue resembling ostitis fibrosa.

Result (1923): Almost seven years after operation, Dr. Prince writes that the palpable mass is no larger, probably smaller; there is no pain or inconvenience. The x-ray (Fig. 11) shows some ossification, but not complete.

Remarks on Case 2: In view of the reported experiences with two cases of large bone cysts, it would seem justifiable to leave this cyst alone, unless x-rays or palpation demonstrate that it is getting larger. Should the cyst get larger, I believe the method of attack should be a crushing operation. This can be done with very little periosteal stripping. As I review the operation in the two previous cases, I get the impression that the operators were attempting to remove as much of the bone shell as possible and did not have in mind crushing the bone shell.

CASE 4. (Pathol. No. 32199): Bone cyst of upper end of femur which has grown to considerable size in twenty-one months. (Figs. 12 and 13.)

Dr. C. B. Francisco of Kansas City writes me that I saw the x-ray in Figure 12 in April 1921, and the boy, aged 13; the duration of the symptoms are not given. He tells me that I advised against operation. The second x-ray (Fig. 13) was taken one year and nine months later and illustrates how rapidly a bone cyst may

Fig 15—Pathol No. 28393. Case VI. X-ray of big bone cyst of upper end of humerus. Boy, aged twelve (?), swelling eighteen months. Patient of Dr Harvey G Mudd of St Louis, Mo. X-ray taken October, 1919. See Figures 16 and 17 for result.

Fig 16—Pathol No. 28393 Case VI. X-ray June, 1920, eight months after x-ray in Figure 16, showing pathological fracture.

Fig 17 Pathol 28393 Case VI. X-ray September, 1921 almost two years after x-ray shown in Figure 15, and about three years and six months after onset. Pathological fracture shown in Figure 16 has healed; the cyst is no smaller, ossification is incomplete. Dr. Mudd writes in 1922 that the patient has good function.

grow, especially when there is no fracture.

Unfortunately I made no copy of what suggestions I made in this case, and I fear that I was misunderstood.

The x-ray in Figure 12, with a known age of thirteen, practically excludes a malignant central bone tumor. One would place such a child on crutches, improve the general condition if indicated, and if further x-ray pictures show no ossification or enlargement of the cyst, immediate operation would be indicated. On the receipt of the x-ray shown in Figure 13 operation was advised. This was in January 1923, and there has been no report since. One, however, could not have a better example of what may happen to a benign bone cyst if there is no fracture and no operation. But I will illustrate later that in a cyst the size of that shown in Figure 12, spontaneous ossification with complete restoration to normal may take place. So one is justified to delay under careful x-ray supervision. It was undoubtedly my fault that I did not make myself clear to Dr. Francisco and put my suggestions in writing.

CASE 5. (Pathol. No. 32153): Figure 14 is an x-ray of a patient observed by Dr. R. B. Morris of Olean, N. Y., in January 1923. The x-ray (Fig. 14) shows a huge cyst of the upper end of the humerus which is largely ossified. When the patient was a boy, thirty-eight years ago, there was an injury to this shoulder, without fracture, followed by gradual swelling of the upper end of the bone. Two years later a shoulder-joint amputation was advised. This operation was refused and after a time the enlargement ceased, but the shoulder-joint became ankylosed. The patient now has fair function, even with the ankylosed joint.

This case, therefore, demonstrates again what may happen in a small percentage of bone cysts in which there is no fracture and no operation.

CASE 6. (Pathol. No. 28393): Figures 15, 16 and 17 illustrate a large bone cyst of the upper end of the humerus which did not ossify after a fracture and is still large and unosssified about five years after onset. This patient was observed by Dr. Harvey G. Mudd of St. Louis, who saw the boy in October 1919 and took the x-ray shown in Figure 15. There was a history of swelling of the upper half of the humerus, of eighteen months' duration. An operation was performed October 15, 1919, removing a small piece of a thin shell of bone and letting out clear fluid. There was no connective-tissue lining. It is interesting to note that this case of Dr. Mudd corresponds to the one I first operated on in 1903. My operation was no more extensive than Dr. Mudd's, yet complete ossification and restoration to normal was observed in ten years and is still present after twenty years. In Dr. Mudd's case this good result did not take place, because in Figure 16 taken in June 1920, eight months later, there is a pathological fracture, and the one taken in September 1921 (Fig. 17) shows as yet no ossification, except in the fracture.

I have observed this slow ossification in cysts of this kind in the upper end of the humerus with and without operation, and I am convinced that quicker and better results will be obtained if x-ray examinations show absence of ossification or increasing expansion, and when one operates, one should not be content with the removal of a small piece of the bone shell and evacuating the fluid, and stripping the connective-tissue lining, but one should completely, or partially crush the bone shell. I feel very positive from my observations that this method of attack is established.

CONCLUSIONS

I have now covered the problems outlined for this paper: First, the methods of diagnosis; second, the method of attack, with emphasis on the crushing of the bone shell; and I have again emphasized that in a small number of bone cysts left alone there may be no ossification, or very little, or with or without ossification the cyst may gradually reach a great size when it not only interferes with function but makes the operation to restore the bone to normal dangerous and, in some instances, impossible.

Therefore, it is of the utmost importance that every case diagnosed bone cyst and which—on account of its size, localization, age of the patient or the presence of fracture—allows one to postpone operation, the patient should be carefully followed with frequent x-ray examinations, so that operation can be resorted to the moment it is indicated. When one operates, it must be remembered that a fracture and best a comminuted fracture (i. e., the crushing of the bone shell) is the method of attack which promises the most complete healing in the shortest space of time.

Pericarditis With Effusion*

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ACUTE pericarditis with effusion occurs most frequently as a complication of the acute infectious diseases, especially acute articular rheumatism and pneumonia, but it may follow a focus of infection anywhere in the body, or contiguous infections, as empyema, etc. Christian, in a study of 53 patients with acute pericarditis, found that 17 of these had at the time, or had recently had, acute articular rheumatism. Stone, in 300 necropsies on pneumonia patients at Fort Riley, found pericarditis present in 74 cases. Fourteen had seropurulent effusions; 44, acute purulent; and 14, acute fibrinoplastic purulent effusions. The amount of fluid varied from 100 to 1,000 c.c., the average being about 350 c.c. in 26 recorded cases. Pericarditis in 54 per cent of the cases was associated with empyema on the left side, in 20 per cent with empyema on the right side. We realize that both pericardial and pleural involvement were more frequent in this epidemic than in the usual run of cases.

The fluid may be serous, serofibrinous, seropurulent, or hemorrhagic, dependent usually on the etiological factors. Chronic pericarditis with effusion, except as a later development, is rare. It is seen more frequently in advanced tuberculosis than in any other chronic infection. Very large effusions are occasionally due to sarcoma or carcinoma metastasis, or may occur in the late stages of leukemia and Hodkgin's disease.

The history is not of great value usually. Pain over the precordium and dyspnea are the most constant complaints, but pain usually subsides as fluid accumulates. Neither, however, occurs with sufficient regularity to be of much value. Before the effusion has reached an amount greater than 150 to 250 c.c., the diagnosis is almost entirely dependent on a to and fro friction rub heard over the

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 8, 1922.

precordium. This is also, in many instances, heard throughout the disease.

After the amount of fluid reaches 200 c.c. or more, the most important physical signs are (1) a to and fro friction rub, (2) extension of the cardiac dulness upward and to the left, (3) substernal dulness, (4) broadening of the heart shadow, (5) physical signs of an area of compressed lung near the angle of the scapula on the left side, and (6) a pushing down of the left lobe of the liver.

Auenbrugger's, Rotch's, Ewart's, Ebstein's, Bamberger's, and Pin's signs are of little practical value in the diagnosis.

Williamson, in a study of the physical signs states:

"1. In pericarditis with effusion the fluid accumulates earliest in the costodiaphragmatic angle. This is manifested clinically in all but very small effusions by a pushing down of the left lobe of the liver which serves as a useful diagnostic criterion.

2. This sign can nearly always be observed before any rounding of the cardiohepatic angle or any increase in the great vessel dulness occurs. The extent to which the edge of the liver is depressed amounts to about two finger-breadths with effusions of 500 to 600 c.c.

3. A pericardial friction rub not only may but does persist with fairly large effusions in about two-thirds of the cases. This is especially true when for any reason there is a disproportionately large heart, so that the latter organ comes into close apposition with the sternum.

4. Pressure signs over the lungs posteriorly occur only with much larger effusions than the signs already enumerated."

Christian, however, believes that dulness near the angle of the scapula on the left side, with broncho-vesicular or bronchial breathing, and bronchophony are very early signs of effusion and may be present when there is only a small quantity of fluid.

Morris and Bader injected the pericardium of four cadavers, using 250, 500, 750, up to 1,500 c.c. of ascitic fluid, and found that the first change on percussion was an increase in the cardiac dulness upward, this amounting to a rise in dulness from the third to the second rib before there was any change to either side. This was usually found after as much as 250 c.c. of the fluid had been injected. Distinct retrosternal dulness occurred in three of the cadavers after an injection of 500 c.c., but in the fourth this was not demonstrable until after 750 c.c. was used. Their cases were not examined in the erect posture. All of the cadavers were also x-rayed with the body lying flat on the back with the x-ray plate posteriorly. With the appearance of retrosternal dulness there was a progressive widening of the mediastinal shadow in the roentgenogram and a general increase in the width of the heart shadow. In none did they find an obtuse cardiohepatic angle. They believe that with a tensely distended pericardium, marked shifting of the dulness with change in position could not be expected. We have, however, not found this to be the case. In the very large effusions the change amounted to 2 or 3 cm. or more. Several areas should be measured, as the greatest change in width of the shadow is not always in the same plane.

Williamson has evidently perfected the technique of liver percussion to a degree that is far beyond the average clinician; and though the pushing down of the left lobe of the liver is undoubtedly an invaluable sign of fluid within the pericardium, the detection of changes in liver dulness of a finger's breadth is always obliged to carry a large percentage of error. The to and fro friction rub can usually be distinguished from a double murmur or pleuropericardial friction, but at times a definite differentiation is extremely difficult.

The roentgen ray has its greatest usefulness in cases where there is an effusion of more than 150 to 200 c.c. in showing approximately the amount of fluid present and in determining the best location for paracentesis. Occasionally when there is a moderate amount of fluid in the pleural space or consolidation in the lung and no to and fro friction present, a diagnosis without the roentgen ray is practically impossible.

Holmes has shown that when the heart is suspended in solutions with a specific gravity between 1.012 and 1.020, its outline cannot be made out by the x-ray. He found an absence of pulsation on fluoroscopic examination about as frequently in markedly dilated hearts as when there was a large effusion. In pericardial effusions the cardiohepatic angle was sometimes acute, sometimes obtuse, and sometimes obliterated. He found this to be equally true in markedly dilated hearts. The angle is more apt to be obliterated if the patient is examined in the upright position. He found an obliteration in the normal outline of the various chambers of the heart in nearly all cases; also that the dulness lies higher toward the sternal notch and is wider at the base when the patient is in the prone position. He was unable to see the outline of the heart shadow within the pericardium in any case.

We have studied rather carefully sixteen cases of pericarditis with effusion. The diagnosis was in fourteen of these checked by necropsy or pericardial tapping. In twelve cases there was 200 or more c.c. present, and in ten of these the x-ray showed definite indications of fluid within the pericardium. Of the five cases not

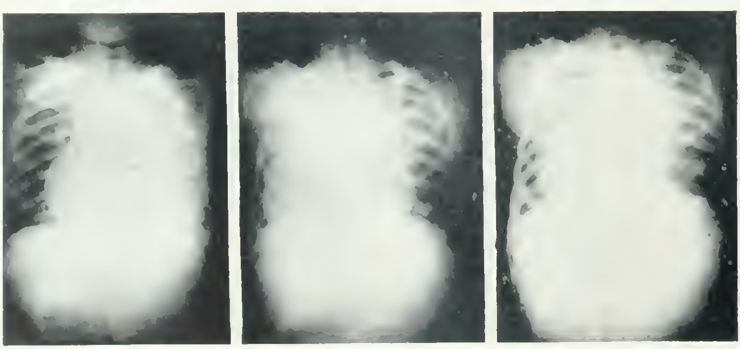

Fig 1—**A**, Boy aged 12. Large pericardial effusion following tonsillitis. **B**, After removal of 500 c.c. of fluid. **C**, After removal of another 500 c.c. Complete recovery.

Fig 2—Large effusion. Extreme dyspnea. Removal of 500 c.c. Patient recovered.

diagnosed by the x-ray, four were in pneumonia patients where the amount of fluid was less than 200 c.c. In these, plates were made only with the patient in the supine position and showed no definite change in the heart or mediastinal shadow. The fifth patient had a very large empyema on the left side. Unless there were definite contraindications, examinations after inspiration and expiration were made with the patient in the erect, supine, and prone positions. The constant findings were (1) a general increase in the width of the cardiac outline, (2) a widening of the mediastinal shadow which changed with change in position of the patient, (3) a straightening out of the curves of the left border of the heart, (4) the absence of or weak cardiac pulsations noted on the fluoroscopic screen, (5) a change in the space formed by the diaphragm, spine, and posterior border of the heart, (6) a bulging of the heart shadow upward and to the left, (7) extension of the mediastinal borders as more or less straight lines up to the clavicle, and (8) in some of the acute fairly large effusions, a hazy more dense appearance to the lung shadow about opposite the angle of the left scapula. (This was more marked with the patient in the prone or supine position, and was less pronounced or absent in the chronic cases).

Where a large pleural effusion accompanies fluid within the pericardium, it is of course impossible to make out the heart outline on the affected side. In one case a large pneumothorax seemed to exert an unequal pressure on the upper part of the mediastinum. In this patient, though we were sure of a pericardial effusion, a widening or change in the width of the mediastinal shadow could not be shown. Autopsy two days later showed the presence of 450 c.c. of purulent effusion. There were no pleuropericardial or mediastinal adhesions. When there are pleuropericardial and mediastinal adhesions, the pericardium may contain several hundred c.c. of fluid and show but very little, if any, change in the mediastinal shadow. Tumor of the pericardium with fluid will give the changes above noted, but the contour will usually be irregular. Some of the patients examined were too ill for us to obtain a perfectly satisfactory fluoroscopic examination. The only definite information obtained from this examination was a change in the space formed by the posterior border of the heart, the diaphragm, and the spine. We have not placed a great deal of dependence on what appeared to be changes in this space, since a markedly dilated heart or tumor may give a very confusing shadow.

The diagnosis of pericarditis is of twofold importance. First, there is so frequently an endocarditis and myocarditis associated with it; and secondly, even though a paracentesis of the pericardium is not usually necessary, whenever it is indicated marked relief of circulatory embarrassment is obtained. Williamson reports that necropsies on two very large pericardial effusions showed that death was due to pressure of the fluid on the auricles, and felt that paracentesis would have been life-saving in both instances. In our series, paracentesis pericardii was done nine times on six different patients and gave marked relief of symptoms in each instance.

Kuno, Lewis, and others have shown that the venous pressure in the heart increases very regularly in proportion to the amount of fluid placed in the pericardial space, but that the arterial pressure decreases very slightly until a large amount of fluid has accumulated. After a certain point, however, it reduces very rapidly. An effusion does its harm by preventing full diastolic distension of the heart. It is for this reason that tapping the periardium gives such relief in some cases.

The roentgen ray is certainly of far more value in the diagnosis of fluid within the pericardium than is credited it by many eminent internists. This is almost certainly due to the fact that negative or positive opinions are routinely given by roentgenologists from either the usual flat plate or a pair of stereoscopic plates made with the patient in one position.

To quote Christian: "Roentgen ray studies in pericarditis have not given very much information. The physical signs are behind the heart shadow and in rotating the body to get a better view you get tangled up with the shadow of the vertebral column and do not get a good picture. The roentgen ray has not helped us much in detecting fluid in the pericardial sack. The roentgenologist diagnoses its presence from the silhouette of the heart. In my experience, there usually is no fluid. My reason for saying that, is that those particular cases diagnosed as pericardial effusions by the roentgenologist often terminate fatally and at necropsy you do not find fluid. I have a number of such cases recorded."

Many other clinicians have about the same opinion. Lichty, Stone, Norris and Landis, Da Costa, and others, however, have great faith in the roentgen ray in the diagnosis of this condition.

A negative diagnosis when there is a fair amount of fluid present is more frequently excusable than is a positive diagnosis when there is no fluid present. In the differential diagnosis of pericarditis with effusion from a dilated heart, some mediastinal tumors, and mediastinal pleurisy, the change in the contour of the shadow with change in the position of the patient is at times the only information of value which can be obtained from the roentgenogram. Naturally, the same positions and same tube-plate distances should be used. A history and regard for the physical examination is not necessary in a great deal of our work, but due regard for these

Fig. 3—**A,** Girl aged 18. Sarcoma of pericardium. Very large effusion. Prone position. **B,** Erect position. After plate was made ,1,350 c.c. of serosanguinous fluid removed. Marked temporary relief of symptoms.

Fig. 4—**A,** Mediastinal shadow normal. Right side empyema. **B,** One week later. The pleura has been drained. Fairly large pericardial effusion.

in many cases of pericarditis will enable the roentgenologist to make a diagnosis without which his interpretation would be incomplete, since it is not always possible to get all the positions, angles, and views we would like.

SUMMARY

1. Before the amount of fluid in the pericardium has reached 200 or more c.c., the diagnosis depends almost entirely on the presence of a to and fro friction rub heard over the precordium.

2. After a fairly large amount of fluid is present, the most constant and dependable physical signs are a persisting to and fro friction rub, extension of the cardiac dulness upward on the left side, substernal dulness which changes with change in the position of the patient, broadening of the heart shadow, the physical signs of an area of compressed lung near the angle of the scapula on the left side, and a pushing down of the left lobe of the liver

3. The x-ray is of little value before 200 or more c.c. of fluid has accumulated. With greater amounts, widening of the mediastinal shadow, a bulging of this shadow upward and to the left, widening of the heart shadow, obliteration of the normal curves of the borders of the heart, extension of the mediastinal borders as more or less straight lines up to the clavicle, and a change in the contour of the heart shadow with change in position of the patient can be determined more accurately by x-ray than by any other means. When there is some fluid in the pleural space or consolidation in the lung, a correct diagnosis may be made when it is practically impossible by any other means.

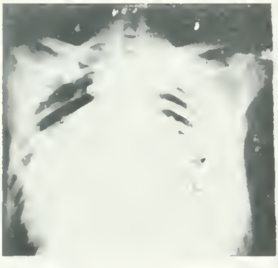

Fig. 5 Pneumothorax. Mediastinal shadow not particularly broad. Large heart shadow. Necropsy two days later showed presence of 450 c.c. of purulent fluid in pericardium.

Fig. 6—Boy, aged 10. Hodgkin's disease. Note the borders of the mediastinal shadow. They are practically straight lines which extend up the clavicle. There is no inward curve at the aortic arch. This appearance is very suggestive of fluid within the pericardium.

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The Holfelder Technique in Deep Therapy

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I wish to present to you, today, the details of a therapy technique developed by Dr. Hans Holfelder, of the Schmieden Clinic, in Frankfurt. The technique is new in that it has not been practiced in America, although it has been in use in Germany for over two years.

There are, at present, two general methods of application of the x-rays for deep therapeutic purposes. One is the Dessauer technique, the other is the "turn it on and let it run an hour" plan. No attack upon the latter method is necessary, nor is it possible to defend it, but if deep therapy is to take its place with other recognized procedures, we must eliminate haphazard and unscientific methods as rapidly as possible.

The successful treatment of malignant disease by x-rays depends largely upon the fulfillment of a comparatively simple requirement; namely, all cells in the area under treatment must be subjected to identical physical conditions; that is, quantitative and qualitative homogeneity are essential. This proposition is more exactly stated in the basic principles laid down by Dessauer:

> 1. The basis of deep therapy is founded upon the biological experience that different cell forms exhibit different sensibilities to x-rays.

2. Different cell sensibilities are manifested to different degrees of hardness of x-rays.

3. These differences in sensibility depend upon the production of a homogeneous field

4. Heterogeneity is detrimental and success cannot be expected if the degree of heterogeneity exceeds the difference in sensibility between the normal and pathological cells. This is the "law of effective action", and may be stated thus:

$I \times T \times Sp > I \times T \times Sn$,

in which I is the intensity of radiation, T is the time of application, Sp is the degree of sensibility of the pathological cells, and Sn is that of the normal cells.

5. Homogeneity must be both qualitative and quantitative. For practical purposes rays are homogeneous if their intensities do not vary more than five per cent.

6. When the field is homogeneous the reaction of the different cells depends upon the degree of hardness of the x-rays.

We have thus established as axiomatic the proposition that homogeneity, both qualitative and quantitative, is the prime essential in deep therapy.

Light and x-rays obey the same physical laws, and if we construct a phantom and study the effect of distance on the intensity of light and the relation of homogeneity to the number and positions of the light cones entering the phantom, we may assume that the same effects will obtain if we substitute cones of x-rays for the light cones. To study these factors, we may construct such a phantom, using a glass tank containing a milky fluid, and lamps within truncated pyramids the sides of which are opaque. If we now cause two such cones of light to illuminate the liquid we see at the point of contact a light-intensity considerably in excess of the intensity of either cone (Fig. 1). If we assume the same picture for x-rays, this means that it is in this light zone that we are in danger of giving a burning dose. If we remove the fields from each other, and increase the angle between them, (Fig. 2), the distribution of light is improved but at the expense of the intensity in the depth; and the distribution of the light is not yet equal. If we oppose the two cones, (Fig. 3), we will readily see that the light intensity is much greater at the edges of the field than in the depth. If, however, we take three fields, each making an angle of 120 with its neighbor, (Fig. 4), there results a quite even distribution of the light in the depth. If we may assume that the same phenomena will occur when cones of x-rays are substituted for the light cones, it becomes apparent that radiation through two fields will not satisfy the requirement of homogeneity. If we continue the experiments upon the phantom we will find that homogeneity may be obtained by the use of three, five or seven fields. Thus, we are forced to return to cross-firing. For experimental purposes Dessauer constructed in his laboratory a phantom containing a series of trays coated with a fluorescent substance, by means of which the path of a cone of x-rays could be traced. On this phantom he was able to demonstrate that accurate or even fairly accurate cross-firing with moderately small fields was a practical impossibility.

If, therefore, we are to use multiple fields, we must have some means for the accurate location of the fields, and for the direction of the ray-cones. But must we use multiple fields? Can we not obtain practical homogeneity by the use of great target-skin-distances, large fields, heavy filtration, high voltages, etc? If we assume again that the distribution of x-ray energy in the body is comparable to that of light energy in the phantom it seems doubtful that homogeneity may be obtained by the use of two fields. If we grant its possibility however, there remain other considerations of equally great importance. We know little of the functions of the various ductless glands; we know little of the effect of radiating large quantities of blood; the effect of radiation on the kidneys, and on the secretions of the gastro-intestinal tract is not clear. Are we justified in radiating large areas of the body, or should we confine, as much as possible, the radiant energy to the diseased area? Should the adrenals and the spleen be destroyed in radiating a pyloric carcinoma? Must we radiate the heart in order to apply an efficient dose to a lung tumor? Holfelder radiated a patient for a gastric cancer. Following the treatment the patient grew worse rather rapidly and died. Another similar case developed Addison's disease. A postmortem examination of this patient showed a destruction of the cortical cells of the adrenals. In conjunction with the biologist, Peiper, Holfelder then undertook the study of the irradiated adrenals of dogs, and found that a dose greater than 70 per cent ESD was sufficient to cause destruction of the cortical cells. Clinically such destruction is accompanied by apathy, adynamia, and more rapid growth of carcinoma cells. A final important consideration is that Holfelder has recently completed the measurement of several thousand ray beams by an improved iontoquantimeter, and has demonstrated the incorrectness of the distribution of x-rays shown in the Dessauer curves.

To meet these conditions, Holfelder has devised the field selector, an instrument which enables us to attain actual homogeneity, to use smaller fields, and to accurately direct the ray-cones to the part to be treated, avoiding important organs which should not be radiated. He has adopted the indication, "percentage depth dose", and for practical purposes we may disregard such depth-intensity indications as the "μ-coefficient", "weakening coefficient", etc. The percentage depth dose is the

Fig. 1.

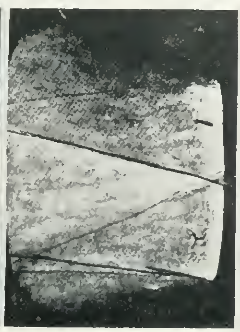

Fig. 2.

Fig. 3.

Fig. 4.

amount of radiation 10 cm. in the depth in relation to the surface dose, expressed in terms of percentage, and may be calculated by the formula:

$$\frac{I' \times 100}{I^2} \quad \text{P. D. D.}$$

I' being the discharge time of the iontoquantimeter with given factors, and I^2 the discharge time with the same factors in a 10 cm. depth. Holfelder believes that the varying degrees of hardness produced by increasing the thickness of an already heavy filter (i. e. the difference between rays passed through 0.8 mm. copper, and those passed through 1.0 mm. copper) are not important biologically, and in using the field selector the various percentage depth doses are produced by varying the size of the field and the target-skin distance, the voltage and filtration remaining constant. Figure 5 shows the effect on the percentage depth dose of varying the field and the distance. The

Proz. Tiefendosis	<	20%	<	<	25%	<	<	30%	<	<	35%	<	<	40%	<	<	45%	Proz. Tiefendosis.
F.Z.A. 23 cm.	6x8	8x10	9x12	10x15	15x15 20x20	--	--	--	--	--	--	--	--	--	--	--	--	F.H.A. 23 cm.
30 cm.	--	6x8	8x10	9x12	10x15	15x15	20x20	--	--	--	--	--	--	--	--	--	--	30 cm.
40 cm.	--	--	6x8	8x10	9x12	10x15	15x15	20x20	--	--	--	--	--	--	--	--	--	40 cm.
50 cm.	--	--	--	--	6x8	8x10	9x12	10x15	16x15	20x20	--	--	--	--	--	--	--	50 cm.
60 cm.	--	--	--	--	--	--	6x8	8x10	9x12	10x15	15x15	20x20	--	--	--	--	--	60 cm.
70 cm.	--	--	--	--	--	--	--	6x8	8x10	9x12	10x15	16x16	20x20	--	--	--	--	70 cm.
80 cm.	--	--	--	--	--	--	--	--	6x8	8x10	9x12	10x15	16x15	20x20	--	--	--	80 cm.
90 cm.	--	--	--	--	--	--	--	--	--	6x8	8x10	9x12	10x16	15x16	20x20	--	--	90 cm.
100 cm.	--	--	--	--	--	--	--	--	--	--	6x8	8x10	9x12	10x15	15x15	20x20	--	100 cm.

Fig. 5.

figures are not correct for all installations and must be verified and corrected before the table may be used.

The field selector consists of a series of "trial fields", which are truncated triangles made of photographically tinted celluloid; (Fig. 6), and an illuminated glass plate on which is printed a series of geometrical figures of varying density and of the same color as the trial fields. The tint of the trial fields progresses from dark to light from above downward, in carefully calculated percentages, the various degrees of intensity of color corresponding to various percentages of the ESD. They are calculated for depth dose percentages of 15, 20, 25, 30, 35, 40, and 45 per cent, each percentage depth dose having a number of trial fields. On the illuminated glass plate are a great number of figures, squares, triangles, points, and circles. Each square, each triangle, each point and each circle is of exactly the same tint, but the circles are much darker than the points, the points are darker than the squares, and the triangles are the lightest of all. If we superimpose a trial field upon the plate of the field selector, say a 25 per cent field, we will see that near its lower border all of the figures may be seen, while at its upper border only the points and circles are visible. When the triangles disappear, a dose of 35 per cent ESD has been surpassed, the quandrangles are no longer visible when an intensity of 70 per cent is reached; at 110 per cent the points disappear, and all figures are invisible at 135 per cent.

Fig. 6

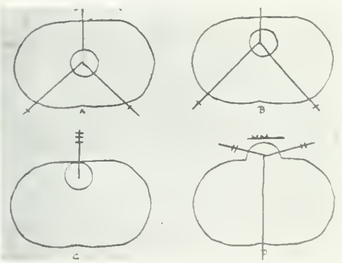

Fig. 7.

The method of application is as follows: By means of caliper measurements and by molding a strip of block tin to the contours of the body a cross-section of the body at the level of the tumor is constructed on the plate of the field selector. By the aid of information obtained at operation, by flouroscopy and x-ray plates, palpation and other clinical means, and with the assistance of a cross-section anatomy, the tumor is located on the section, and the organs seen in such a section are drawn in. The trial fields are chosen by experience, combined with certain fundamental principles which may be briefly outlined: To a centrally located tumor, three fields of equal intensity are applied, with an angle of 120° between each pair of fields (Fig. 7A). To an acentrally located tumor is applied one field of greater intensity from the nearest side and two fields of equal lesser intensity, each field

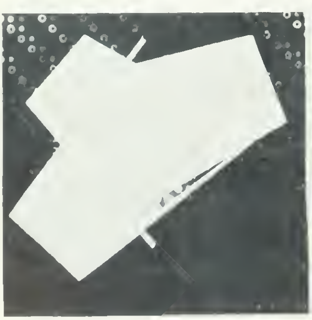

Fig. 8—Homogeneity not good

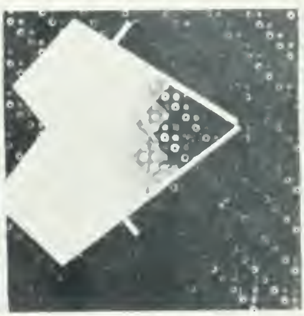

Fig. 9—Homogeneity not good.

Fig. 10—No homogeneity

making an angle of 120° with its neighbor (Fig. 7B). Having an extremely eccentric tumor, located immediately under the skin, cross-firing is not attempted because of the danger of skin injury. For these cases a single field of great intensity is used at a very great target skin distance (100 cm.) with two tubes radiating the same area simultaneously (Fig. 7C). When a tumor projects above the skin, the surface of the tumor is protected with lead, and two fields of great intensity are applied obliquely, with one field of less intensity from the opposite side (Fig. 7D). Bearing in mind these general principles, we may select the trial fields by trial and error. The fields are arranged on the field selector plate so that the area to be irradiated is covered, the homogeneity is judged and the degree of intensity in the radiated field is calculated. With some practice, the error is less than five per cent. If the homogeneity in the irradiated field is not good, (Figs. 8 and 9), one or more of the trial fields may be changed to fields of greater or lesser intensity, or the direction of the field may be altered, or the skin dose may be increased or decreased as indicated, until the required dose and an adequate homogeneity have been obtained. A piece of tracing paper is then placed on the plate of the field selector, the whole section, including the trial fields is drawn on the paper, and the fields are projected out into space beyond the limits of the section (Fig. 11). On the tracing is noted the percentage depth dose required for each field, and the percentage of an ESD delivered to each skin area is noted on each field. Now one selects one of a number of patterns which have been cut to fit the contours of various sections of various sized bodies, and adjusts it to fit the section under consideration (Fig. 12). The anterior field or fields are now projected onto their patterns, the posterior field or fields are cared for in a like manner. If this pattern be applied to the body at the level of the section, and the central beam is caused to pass parallel to the center of the plane field which was projected onto the pattern, it is obvious that the condition within the body will be identical with that produced on the field selector. If any important organs, the radiation of which is undesirable, appear in the section, the fields may be so applied as to cause these organs to be without the path of the direct radiation. In certain cases, in the radiation of pyloric carcinoma, carcinoma of the pancreas, etc., it becomes necessary to prepare sagittal sections in a like manner in order to avoid radiation of the adrenals (Fig. 13).

SUMMARY

(1) Homogeneity in the radiated area is a prime essential.

(2) Better homogeneity is obtained by using three or five fields than by the use of two or four.

(3) The use of small fields is necessary for the treatment of disease in certain regions.

(4) The Holfelder field selector offers a means of attaining better homogeneity.

(5) It permits of accurate cross-firing.

(6) It enables the ray-cones to be directed in such a manner as to avoid the radiation of important uninvolved organs.

(7) It therefore offers the most accurate and scientific means of applying x-rays for deep therapy.

820 Peoria Life Bldg.

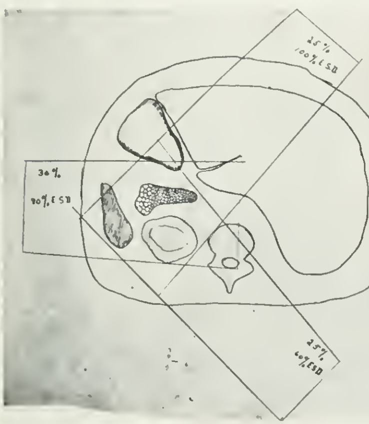

Fig. 11.

Fig. 12.

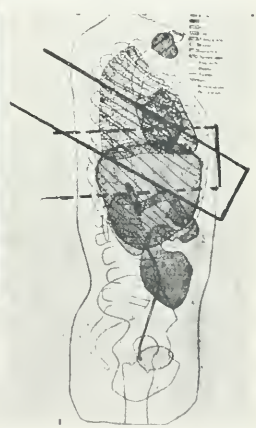

Fig. 13.

A System of Roentgen Ray Anthropometry (The Skull)*

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PART III. SECTION A.
Descriptive Anthropologic Data.

No. 1. Name, Helen Q. Age, 24 years. Sex, female. Height, 5 feet 3 inches. Weight, 135 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The skull appears thicker than usual. A few teeth are missing. Not any of the sutures are clearly visible, neither is there any deformity suggestive of abnormal synostosis.

No. 2. Name, Mollie P. Age, 25 years. Sex, female. Height, 5 feet 4 inches. Weight, 160 pounds. Physical condition, good excellent recovery from breast amputation July 9, 1920 (carcinoma). Clinical diagnosis, acute mania. Descriptive observation: The bones are of medium thickness; the thinnes of the lower jaw and the very obvious decay of teeth would suggest an age much older than her history shows. None of the coronal suture is visible. The second portion of the lambdoidal suture shows serrations partially occluded. There is complete absence of frontal sinuses. The skull is not deformed nor are there evidences of premature synostosis.

No. 3. Name, George A. Age, 50 years. Sex, male. Height, 5 feet 9 inches. Weight, 160 pounds. Physical condition, fair. Clinical diagnosis, dementia praecox. Descriptive observation: The skull is of medium thickness. There are evidences of pressure burrows on the inner aspect of the entire median sagittal section of the vault. The teeth are in good condition. The middle portion of the lambdoidal suture is barely visible. The frontal sinus is spacious and markedly protrudes. The vertex of the skull is flattened, tending slightly to scaphocephalic depression; from which premature occlusion of the sagittal suture is inferred.

No. 4. Name, J. W. M. Age, 45 years. Sex, male. Height, 5 feet 5 inches. Weight, 140 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The skull is below average thickness. Many teeth are missing. No part of the coronal suture is visible; and the second part of the lanbdoidal suture is much fused. There is a slight bulge at the bregma suggesting a tendency to acrocephaly. The frontal sinuses are absent, though the superciliary ridge is developed. There is a tendency to flattening from the occipital protuberance to the menton. In this case the sex evaluation is less than 21 though the actual sex is that of a male.

No. 5. Name, A. R. Age, 50 years. Sex, male. Height, 5 feet 8 inches. Weight, 140 pounds. Physical condition, poor. Clinical diagnosis, Paresis. Descriptive observation: The bones are of variable thickness, being in places quite thin and in other places markedly thick. The frontal and parietals in the region of the sagittal suture show burrowing, possibly of pressure. The teeth are in poor condition, many missing and some of the remaining ones showing decay. None of the coronal suture is visible; but the middle and third portions of the lambdoidal suture are clearly revealed. The general shape of the head does not argue for sutural synostosis. The critical sex values enumerated from the skull are clearly feminine; whereas the patient is a male. The clinical diagnosis is paresis.

No. 6. Name, S. A. Age, 40 years. Sex, male. Height, 5 feet 6 inches. Weight, 150 pounds. Physical condition, good. Clinical diagnosis, mental deterioration. Descriptive observation: The bones are of average thickness. There are many teeth missing. The middle portion of the coronal suture is visible and the entire lambdoidal suture can be traced with apparent lack of fusion. There is a very gentle scaphocephalic indentation at the vertex.

No. 7. (No clinical record of this case.) Descriptive observation: Bones are of average thickness. None of the coronal nor lambdoidal sutures is visible. Pronounced scaphocephalic depression. Measurements not made owing to the opened mouth.

No. 8. Name, Christopher C. Age, 35 years. Sex, male. Height, 6 feet 0 inches. Weight, 165 pounds. Physical condition, good. Clinical diagnosis, dementia praecox (recovered). Descriptive observation: The bones are somewhat thicker than usual. Only part of the middle portion of the lambdoidal suture can be visualized, the serrations being mostly occluded by fusion. The teeth are good. There is a decided scaphocephalic indentation at the vertex. The direction from occipital protuberance to the menton is almost rectilinear. In this case it is interesting to observe a high sex evaluation corresponding to the true clinical sex of the patient; and with this high evaluation a reported recovered condition. There is almost a rectilinear line from the occipital protuberance to the menton.

No. 9. Name, Thomas W. Age, 30 years. Sex, male. Height, 5 feet 6 inches. Weight, 160 pounds. Physical condition, good. Clinical diagnosis, undifferentiated psychosis. Descriptive observation: The skull bones are thicker than usual. The teeth are in fair condition. None of the coronal suture is visible; but the second and third portions of the lambdoidal suture are clearly seen. The frontal sinus is entirely obliterated, though the superciliary ridge is prominent.

No. 10. Name, Santiago A. Age, 26 years. Sex, male. Height, 5 feet 3 inches. Weight, 120 pounds. Physical condition, (?). Clinical diagnosis, dementia praecox and tuberculosis. Descriptive observation: Skull bones of medium thickness. The teeth are in fair condition, only a few missing. The coronal suture is not observed; only a part of the middle portion of the lambdoidal suture can be visualized, though so fused as to present practically complete occlusion. The head tends to acrocephaly, pointing to sutural synostosis of the coronal. Frontal sinuses are absent, though there is a developed superciliary ridge.

No. 11. Name, Edwin J. R. Age, 24 years. Sex, male. Height, 5 feet 11 inches. Weight, 160 pounds. Physical condition, good. Clinical diagnosis, paresis. Descriptive observation: The bones are somewhat thick and osteoporotic. Both the coronal and lambdoidal sutures are visible. There is no evidence of unusual sutural synostosis. The teeth are in good condition. There is a straight line from the occipital protuberance to the menton.

No. 12. Name, Earl S. Age, 30 years. Sex, male. Height, 5 feet 7 inches. Weight, 145 pounds. Physical condition, poor. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are of average thickness. Some teeth are missing. Step-like depression at the lambda. None of the coronal suture is visible. The first, second and third portions of the lambdoidal suture are closely traced and are obviously unfused. Practically a straight line can be traced from the menton to the occipital prominence. The frontal sinus is entirely absent though there is present a pronounced supraorbital ridge.

*Continued from October, 1922.

No. 13. Name, G. H. S. Age, 25 years. Sex, male. Height, 5 feet 8 inches. Weight, 140 pounds. Physical condition, good. Clinical diagnosis, praecox—hebephrenic. Descriptive observation: The bones are of average thickness, eburnated on the inner surface, more markedly osteoporotic from the bregma to the lambda. The middle portion of the coronal suture and the entire lambdoidal suture can be visualized. The teeth are in poor condition. There is a flattening of the vertex indicative of scaphocephaly incident to premature synostosis of the median sagittal suture.

No. 14. Name, Wm. T. K. Age, 51 years. Sex, male. Height, 5 feet 6½ inches. Weight, 140 pounds. Physical condition, good. Clinical diagnosis, homosexual. Descriptive observation: Bones, of average thickness. Teeth, in good condition. None of the coronal suture is visible. A fused middle portion of the lamboidal suture can be visualized. There is a clear preponderance in the relation of the head to face in favor of the head. The critical sex index is 20; a feminine critical sex index in a male patient. It is interesting to note the clinical diagnosis of homosexuality.

No. 15. Name, Leonard A. R. Age, 21 years. Sex, male. Height, 5 feet 10 inches. Weight, 140 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are not extraordinarily thick. There are signs of pressure erosion on the frontal and parietal bones near the median sagittal section. The teeth are poor, a number are missing. The coronal suture is not visualized; the median portion of the lambdoidal suture is visible but is partly occluded owing to fusion. The sex evaluation is below 21, contrary to the actual sex of the individual.

No. 16. Name, Joseph Z. Age, 40 years. Sex, male. Height, 5 feet 7 inches. Weight, 140 pounds. Physical condition good. Clinical diagnosis, paranoid dementia praecox—homosexual. Descriptive observation: The bones are thinner than in average normal. The head is irregular in outline. It shows pressure marks in the frontal region. It tends to brachycephaly. The teeth are in fair condition. No portion of either the coronal or the lambdoidal suture is visible.

No. 17. Name, Phillip N. Age, 36 years. Sex, male. Height, 6 feet. Weight, 200 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The skull bones are of average thickness. The teeth are in fair condition. Coronal suture is not visible; second portion of lambdoidal suture can be traced. Moderate flattening at the vertex suggests sagittal suture synostosis. There is almost a rectilinear line from the occipital protuberance to the menton. This individual, six feet tall and 200 pounds in weight, has a skeletal head evaluation below the critical sex index.

No. 18. Name, Morris Q. Age, 32 years. Sex, male. Height, 5 feet 5¼ inches. Weight, 128 pounds. Physical condition, good. Clinical diagnosis, toxic psychosis. Descriptive observation: Thin bones. Good teeth. The middle portion of the coronal suture and the entire lambdoidal suture are visible. The frontal sinus is congenitally absent. There is a scaphocephalic depression at the vertex suggesting median sagittal sutural synostosis. There is a straight line from the occipital protuberance to the menton. The sex evaluation is less than 21, though the individual is a male patient.

No. 19. Name, Bernard N. Age, 28 years. Sex, male. Height, 5 feet 5 inches. Weight, 140 pounds. Physical condition, fair. Clinical diagnosis, hebephrenic praecox. Descriptive observation: The bones are of average thickness, lambdoidal suture is visible in its middle part, coronal suture not seen. There is a straight line from the occipital protuberance to the menton. It is interesting to note the presence of the straight line from the protuberance to the chin together with the clinical diagnosis of hebephrenic praecox.

No. 20. Name, Frank M. Age, 32 years. Sex, male. Height, 5 feet 9 inches. Weight, 140 pounds. Physical condition, good. Clinical diagnosis, paresis. Descriptive observation: The bones are of average thickness. There is a scaphocephalic depression at the vault. Only a part of the lambdoidal suture can be seen. The teeth are poor. There is a straight line from the occipital protuberance to the menton.

No. 21. Name, Wm. C. L. Age, 35 years. Sex, male. Height, 5 feet 5 inches. Weight, 135 pounds. Physical condition, fair. Clinical diagnosis, paranoid dementia praecox. Descriptive observation: Bones, thin anteriorly and thick posteriorly; rickety ridge at the bregma; lambdoidal and coronal sutures visible. Slight tendency to scaphocephaly.

No. 22. Name, Thomas S. Age, 30 years. Sex, male. Height, 5 feet 9 inches. Weight, 150 pounds. Physical condition, good. Clinical diagnosis, paarnoid dementia praecox—homosexual. Descriptive observation: The bones are everywhere thick in median sagittal section; lambdoidal suture just visible; teeth poor. There is a straight line from the occipital protuberance to the chin point.

No. 23. Name, Albert C. Age, 35 years. Sex, male. Height, 5 feet 10 inches. Weight, 175 pounds. Physical condition, good. Clinical diagnosis, alcoholic hallucinosis. Descriptive observation: The bones are of average thickness. The internal surface is irregular. The head is brachycephalic. The frontal sinuses are absent. There is a step-like elevation at the lambda. The lambdoidal suture is visible in its middle part. The critical sex index is 20.

No. 24. Name, Ralph H. Age, 25 years. Sex, male. Height, 5 feet 8 inches. Weight, 165 pounds. Physical condition, good. Clinical diagnosis, maniac depressive psychosis. Descriptive observation: The bones are thin. The coronal suture is barely visible in its middle portion; whereas the entire lambdoidal suture can be seen. The teeth are good. There is a flattening of the vertex suggesting a scaphocephalic tendency.

No. 25. Name, Otto J. S. Age, 31 years. Sex, male. Height, 5 feet 10½ inches. Weight, 170 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are thin and irregular. There is some osteoporosis and pressure erosion in the frontal and parietal sagittal regions. The middle portion of the coronal suture is visible, as is also the entire lambdoidal suture.

No. 26. Name, Chris. P. Age, 60 years. Sex, male. Height, 5 feet 8 inches. Weight, 147 pounds. Physical condition, good. Clinical diagnosis, dementia praecox with syphilis. Descriptive observation: The bones are thin. The middle portion of the coronal and the entire lambdoidal suture are visible. There is a very slight flattening at the vault. The lambda is depressed. The teeth are fair.

No. 27. Name, Wm. L. W. Age, 23 years. Sex, male. Height, 5 feet 6 inches. Weight, 125 pounds. Physical condition, good. Clinical diagnosis, undifferentiated psychosis. Descriptive observation: The bones are of medium thickness, irregular and eburnated on the inner surface. They are osteoporotic. There is evidence of pressure erosion in the frontal sagittal region. A part of the coronal suture is visible as is also the lambdoidal.

No. 28. Name, M. S. Age, 20 years. Sex, male. Height, 5 feet 6 inches. Weight, 136 pounds. Physical condition, good. Clinical diagnosis, catatonic dementia praecox. Descriptive observation: The bones are

of average thickness but obviously osteoporotic. The coronal suture is nowhere visible. The middle portion of the lambdoidal suture is in large part occluded, but can be traced. The teeth are in good condition. The head tends to brachycephaly. There is a straight line from the occipital protuberance to the chin.

No. 29. Name, Roland T. Age, 31 years. Sex, male. Height, 5 feet 4 inches. Weight, 120 pounds. Physical condition, good. Clinical diagnosis, undifferentiated psychosis—not homosexual. Descriptive observation: The bones are thicker than usual. There is an acute angle of Welcker and a very small sella. The coronal suture is barely visible in the middle portion. The lambdoidal suture is practically occluded though the course can be traced.

No. 30. Name, Alfred Y. Age, 27 years. Sex, male. Height, 5 feet 7 inches. Weight, 140 pounds. Physical condition, good. Clinical diagnosis, defective (praecox?). Descriptive observation: The bones are a little thicker than usual, irregular and slightly eburnated on their inner surface. There is a pronounced scaphocephalic depression at the vertex. The coronal suture is not visible. The middle portion of the lambdoidal is straightened and partly occluded. There is evidence of premature occlusion of the saggittal suture. The teeth are good. There is a moderate superciliary ridge with an infantile frontal sinus enclosed.

No. 31. Name, G. O'N. Age, 27 years. Sex, male. Height, 5 feet 6 inches. Weight, 140 pounds. Physical condition, fair. Clinical diagnosis, dementia praecox—hebephrenic. Descriptive observation: The bones are thin. All of the upper teeth and most of the lower teeth are missing. The median portion of the coronal suture is distinctly visible, as is also the entire lambdoidal suture. There is an obvious disproportion from head to face in favor of predominant cranium. There is practically a straight line from the occipital protuberance to the menton.

No. 32. Name, Urbin L. B. Age, 19 years. Sex, male. Height, 5 feet 6 inches. Weight 138 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are of average thickness. The teeth are good. None of the coronal suture is visible; but the median portion of the lambdoidal suture can be seen partly fused. The skull appears brachycephalic. There are signs of pressure erosion in the parietal near the median sagittal suture. In this case the critical index is just barely exceeded.

No. 33. Name, George N. Age, 32 years. Sex, male. Height, 5 feet 6 inches. Weight, 130 pounds. Physical condition, good. Clinical diagnosis, dementia praecox—hebephrenic. Descriptive observation: The bones are thin. The teeth are good. The second portion of the coronal suture and the entire lambdoidal suture can be seen. There is a straight line from the occipital protuberance to the menton. The head is brachycephalic and moderately acrocephalic. There is some pressure erosion in the frontal sagittal area.

No. 34. Name, Irene R. Age, 22 years. Sex, female. Height 5 feet 2 inches. Weight, 131 pounds. Physical condition, good. Clinical diagnosis, Mental defective state with excitement—not homosexual. Descriptive observation: The bones are of average thickness. None of the coronal suture is visible; and the median portion of the lambdoidal suture is faintly seen. The teeth are fair.

No. 35. Name, Hyman F. Age, 28 years. Sex, male. Height, 5 feet 5 inches. Weight, 130 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are thin anteriorly and above average thickness posteriorly. They are everywhere osteoporotic in the median sagittal plane. Frontally and parietally there is marked evidence of pressure erosion. The coronal suture is visible. The entire lambdoidal suture can be seen. There is a moderate superciliary ridge with absence of frontal sinus. The teeth are in fair condition.

No. 36. Name, Clarence J. W. Age, 23 years. Sex, male. Height 5 feet 8 inches. Weight, 160 pounds. Physical condition, good. Clinical diagnosis, dementia praecox—hebephrenic. Descriptive observation: The bones are above average thickness. The internal surface is moderately eburnated. There are Pacchionian bodies along the median sagittal plane. There is a depression at the bregma. In the frontal sagittal region pressure erosion marks are visible. Only the middle portion of the coronal suture can be visualized. The middle portion of the lambdoidal suture is fused, though the course of this suture can be traced. The critical index is 20. There is a straight line from the occipital protuberance to the chin.

No. 37. Name, P. P. Age, 45 years. Sex, male. Height, 5 feet 8 inches. Weight, 150 pounds. Physical condition, good. Clinical diagnosis, paranoid state. Descriptive observation: The bones are not thicker than usual. There is a scaphocephalic depression at the vertex. The middle portion of the lambdoidal suture can be plainly traced. The teeth are in fair condition. There is a straight line from the occipital protuberance to the menton.

No. 38. Name, Michael B. Age, 25 years. Sex, male. Height, 5 feet 4 inches. Weight, 120 pounds. Physical condition, fair. Clinical diagnosis, catatonic praecox. Descriptive observation: The bones are of average thickness, with moderate eburnation on the inner surface. There is considerable evidence of pressure erosion along the frontal and parietal sagittal regions. The middle portion of the coronal suture is barely visible. The middle portion of the lambdoidal suture is straightened and in part occluded. There is a straight line from the occipital point to the menton. The teeth are in poor condition.

No. 39. Name, Floyd D. Age, 23 years. Sex, male. Height, 5 feet 6 inches. Weight, 108 pounds. Physical condition, good. Clinical diagnosis, homosexual. Descriptive observation: The bones are thicker than average and everywhere osteoporotic. In the frontal parietal sagittal region there is evidence of pressure erosion. The coronal suture is visible in its middle portion. The lambdoidal suture is just visible in its middle portion. The teeth are good. The critical index is below 21.

No. 40. Name, James A. M. Age, 20 years. Sex, male. Height, 5 feet 6 inches. Weight, 130 pounds. Physical condition, fair. Clinical diagnosis, praecox—catatonic?. Descriptive observation: The bones are of average thickness. The teeth are poor. The entire lambdoidal suture is visualized. There is a moderate scaphocephalic indentation at the vertex, suggesting median sagittal sutural synostosis. There is a straight line from the occipital protuberance to the menton. The sex evaluation is for a female, though the individual is a male. There is a great preponderance of head over face. There are pressure erosions in the frontal near the median plane.

No. 41. Name, Charles G. S. Age, 24 years. Sex, male. Height, 5 feet 8 inches. Weight, 140 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are thin; the teeth are poor. A portion of the coronal suture can be seen. The lambdoidal is partly obfuscated in the middle portion, which is the only visible part of this suture. There is a scaphocephalic depression at the vertex. There are signs of moderate pressure erosion in the frontal. There is a straight line from the occipital protuberance to the menton.

No. 42. Name, Santiago N. Age, 28 years. Sex, male. Height, 5 feet 4 inches. Weight, 125 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are thin. The teeth are good. Neither the coronal nor lambdoidal suture is visible. The head is acrocephalic. There is pressure erosion in the parietal and frontal and calcification of the falx cerebri in the frontal and occipital region. This case should be eliminated from the studies by reason of foreign parentage.

No. 43. Name, Harry C. Age, 29 years. Sex, male. Height, 5 feet 6 inches. Weight, 140 pounds. Physical condition, good. Clinical diagnosis, homosexual. Descriptive observation: The bones are thick. The teeth are poor. Neither the coronal nor lambdoidal suture is visible. There is a scaphocephalic depression at the vertex with a frontal bulging, suggesting median sagittal and coronal sutural synostosis. There is a straight line from the occipital protuberance to the menton. This case bears a clinical diagnosis of homosexuality; that is a mental case in which homosexual trends are markedly developed and clinically elicited. Though a man, the sex evaluation falls on the critical index.

No. 44. Name, Albert W. Age, 25 years. Sex, male. Height, 5 feet 10 inches. Weight, 170 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are of average thickness. The teeth are good. A portion of the coronal and the middle part of the lambdoidal suture are visible. There is an occipital bulging. There is marked pressure erosion in the frontals. Some Pacchionian bodies project from the falx cerebri along its course. The line from the occipital protuberance to the menton is straight.

No. 45. Name, Sterling H., Age, 28 years. Sex, male. Height, 5 feet 5 inches. Weight, 135 pounds. Physical condition, fair. Clinical diagnosis, catatonic dementia praecox. Descriptive observation: The bones are of usual thickness; teeth in good condition. The middle portion of the coronal and lambdoidal sutures are both clearly visible. The head tends to scaphocephaly. The line from the occipital protuberance to the menton is practically straight.

No. 46. Name, Benj. L. Age, 26 years. Sex, male. Height, 5 feet 7 inches. Weight, 150 pounds. Physical condition, good. Clinical diagnosis, undifferentiated psychosis. Descriptive observation: The bones are of average thickness with greatly uneven internal surface and marked erosion along the frontal, parietal and sagittal areas. The internal diploic edges appear eburnated. There is a congenital absence of the frontal sinuses. The coronal suture is visible in its median portion. The entire lambdoidal suture can be traced. The cranium is rounded so as to suggest an infantile hydrocephaly. and flattened on the vertex indicating a scaphocephaly. The critical sex index for this individual is 21.

No. 47. Name, Mary M. Age, 72 years. Sex, female. Height, 5 feet 4 inches. Weight, 82 pounds. Physical condition fair. Clinical diagnosis, senile dementia. Descriptive observation: The bones are thick; teeth, poor. Neither the coronal nor the lambdoidal suture is visible in any part.

No. 48. Name, Thomas E. K. Age, 20 years. Sex, male. Height, 5 feet 4 inches. Weight 150 pounds. Physical condition, good. Clinical diagnosis, confusion. Descriptive observation: The bones are thicker than average normal. The teeth are fair. No part of the coronal suture is visible. A small part of the middle portion of the lambdoidal suture is barely visible.

No. 49. Name, Joseph T. K. Age, 36 years. Sex, male. Height 5 feet 6 inches. Weight, 160 pounds. Physical condition, good. Clinical diagnosis, maniac depressive psychosis. Descriptive observation: This roentgenogram is not sufficiently satisfactory for diagnosis.

No. 50. Name, George G. Age, 36 years. Sex, male. Height, 5 feet 9½ inches. Weight, 140 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The head is dominantly scaphocephalic. There is a flattening of the vault and a flattening of the occipital surface. The bones are of average thickness. The coronal suture is not visible. The lambdoidal suture is well serrated and plainly traced. The teeth are poor.

No. 51. Name, John N. Age, 34 years. Sex, male. Height, 5 feet 5 inches. Weight, 135 pounds. Physical condition, good. Clinical diagnosis, dementia praecox—hebephrenic. Descriptive observation: The bones are somewhat thicker than average and osteoporotic on their outer surface. The middle portion of the coronal suture is seen. The lambdoidal suture is in part occluded, though its course may be traced. There is a suggestion of pressure erosion, parietally and sagittally. The teeth are excellent. There is a straight line from the occipital protuberance to the menton.

No. 52. Name, Walter R. P. Age, 31 years. Sex, male. Height, 5 feet 10½ inches. Weight, 150 pounds. Physical condition, good. Clinical diagnosis, paresis. Descriptive observation: The bones are of average thickness. There is a scaphocephalic depression of the vault. The middle portion of the coronal suture is almost completely occluded, though its course is faintly indicated. The lambdoidal suture is much straightened, the serrations lost, but its course easily traced.

No. 53. Name, Anna G. Age, 60 years. Sex, female. Height, 5 feet 3 inches. Weight, 120 pounds. Physical condition, poor. Clinical diagnosis, senile dementia. Descriptive observation: The bones are of average thickness though everywhere osteoporotic. The coronal suture can be traced. The lambdoidal suture can be traced with difficulty. There is evidence of pressure erosion in the frontal sagittal region. There is a straight line from the occipital protuberance to the menton.

No. 54. Name, Cora P. Age, 37 years. Sex, female. Height, 5 feet 2 inches. Weight, 140 pounds. Physical condition, good. Clinical diagnosis, epilepsy—homosexual. Descriptive observation: The bones are of average thickness. The lambdoidal suture is much straightened and occluded, though its course is visible. The teeth are in fair condition. There is an occipital flattening, and a straight line runs from the occipital protuberance to the menton. The head tends to brachycephaly.

No. 55. Name, Josephine G. Age, 40 years. Sex, female. Height, 5 feet 6 inches. Weight, 140 pounds. Physical condition, fair. Clinical diagnosis, diabetes. Descriptive observation: The skull is of average thickness. Only a portion of the lambdoidal suture is visible. Teeth, extremely poor; the lower jaw practically edentulous. Vertex is flattened. There is practically a straight line from the occipital protuberance to the menton.

No. 56. Name, Mildred C. Age, 29 years. Sex, female. Height, (?). Weight, 129 pounds, Physical condition, excellent. Clinical diagnosis, dementia praecox—hebephrenic. Descriptive observation: The bones are slightly thicker than average. There are evidences of pressure erosion in the frontal region. A portion of the lambdoidal suture is visible, though faintly. The teeth are good. There is a straight line from the occipital protuberance to the menton. The critical sex value is 21.

No. 57. Name, Ethel D. Age, 36 years, Sex, female. Height, 5 feet 4½ inches. Weight, 106 pounds. Physical condition, fair. Clinical diagnosis, homosexual. Descriptive observation: The bones are thicker than

usual. The lambdoidal suture is barely visible. There is a slight scaphocephalic indentation at the vertex. The teeth are in a fair condition. The critical sex index is 21.

No. 58. Name, Mary M. Age, 40 years. Sex, female. Height, 5 feet 4 inches. Weight, 130 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observations: The bones are of average thickness and irregular on the inner surface in the median plane. The lambdoidal suture is visible. The head tends to scaphocephaly. There is a straight line from the occipital protuberance to the basion. The patient is practically edentulous.

No. 59. Name, Ada F. Age, 48 years. Sex, female. Height, (?). Weight, 179 pounds. Physical condition, good. Clinical diagnosis, secondary dementia following an attack of acute melancholia. Descriptive observation. The bones are of uneven thickness and show eburnation on the inner surface. The cranium is preponderantly masculine in sharp distinction to the feminine face. The lower jaw is practically edentulous and many teeth are missing from the upper jaw. There is almost a straight line from the occipital protuberance to the point of the chin. Neither the coronal nor the lambdoidal suture is visible.

No. 60. Name, Elizabeth H. Age, 33 years. Sex, female. Height 5 feet 3¾ inches. Weight, 106 pounds. Physical condition, excellent. Clinical diagnosis, dementia praecox. Descriptive observation:—This picture is too poor for reading. Unsatisfactory x-ray.

No. 61. Name, Florence M. Age, 53 years. Sex, female. Height, 5 feet 2 inches. Weight, 150 pounds. Physical condition, excellent. Clinical diagnosis, paranoid dementia praecox. Descriptive observation: This x-ray is rejected because of race. (Colored).

No. 62. Name, Mattie F. Age, 19 years. Sex, female. Height, 5 feet 0 inches. Weight, 100 pounds. Physical condition, good. Clinical diagnosis, homosexual. Descriptive observation: The bones are of average thickness. A statement as to the condition of the sutures is not valuable because of the poorness of the x-ray.

No. 63. Name, Annie L. Age, 36 years. Sex, female. Height, 5 feet 2¾ inches. Weight, 132 pounds. Physical condition, fair. Clinical diagnosis, dementia praecox. Descriptive observation: Description discarded because of race. (Colored).

No. 64. Name, Amander D. Age, 44 years. Sex, female. Height, 5 feet 5 inches. Weight, 120 pounds. Physical condition, good. Clinical diagnosis, homosexual. Descriptive observation:—Excluded because of race. (Colored).

No. 65. Name, Maud M. Age, 37 years. Sex, female. Height, 5 feet 6 inches. Weight, 92 pounds. Physical condition, good. Clinical diagnosis, paranoid dementia praecox. Descriptive observation: The bones are of average thickness. The coronal suture can not be seen. The lambdoidal suture can be traced in its entire course. The teeth are fair. There is a scaphocephalic depression at the vault, though the head is not dominantly scaphocephalic.

No. 66. Name, Mary W. Age, 50 years. Sex, female. Height, 5 feet 3¾ inches. Weight, 132 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are thick and irregular. In the frontal region they show marks of pressure erosion. Coronal suture can not be traced. The lambdoidal suture is barely visible. The teeth are in poor condition. The sella is practically completely closed although the angle of Welcker is markedly acute. There is a straight line from the occipital protuberance to the menton.

No. 67. Name, Mary B. Age 56 years. Sex, female. Height, 5 feet 8 inches. Weight, 115 pounds. Physical condition, fair. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are thicker than average normal and markedly irregular especially on their inner surface. There is a moderate pressure erosion in the frontal region. The teeth are poor, the lower jaw and upper jaw being virtually edentulous. No part of the coronal suture is seen. The lambdoidal suture has lost its serrations, is straightened and barely visible. There is a straight line from the occipital protuberance to the menton.

No. 68. Name, Elizabeth B. Mc. Age, 65 years. Sex, female. Height, 5 feet 6¾ inches. Weight, 161 pounds. Physical condition, good. Clinical diagnosis, paranoid state of dementia praecox. Descriptive observation: The bones are somewhat thicker than average. The inner surface is eburnated. A part of the middle portion of the coronal suture is visible. The course of the lambdoidal suture can barely be traced. There is marked osteoporosis everywhere and evidence of pressure erosion in the frontal sagittal region. The teeth are extremely poor. There is a straight line from the occipital protuberance to the menton.

No. 69. Name, Florence N. Age, 79 years. Sex, female. Height, 5 feet 7 inches. Weight, 100 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are thicker than average normal. There is marked pressure erosion in the frontal region. The cranium is preponderantly larger than the face. The teeth are fair.

No. 70. Name, Claudine S. Age, 30 years. Sex, female. Height 5 feet 5 inches. Weight, 130 pounds. Physical condition, poor. Clinical diagnosis, maniac depressive. Descriptive observation: Excluded because of race. (Colored).

No. 71. Name, Margaret B. Age, 49 years. Sex, female. Height, 5 feet 7 inches. Weight, 140 pounds. Physical condition, good. Clinical diagnosis, paranoid dementia praecox. Descriptive observation: No film for this case.

No. 72. (No clinical record given of case.) Descriptive observation: The bones are of average thickness. Only a portion of the lambdoidal suture is visible. The teeth are fair. There is no clinical record of this case.

No. 73. Name, Emma K. Age 50 years. Sex, female. Height, 5 feet 2 inches. Weight, 120 pounds. Physical condition, fair. Clinical diagnosis, toxic psychosis. Descriptive observation: The bones are of average thickness. There is an osteoporotic area in the region of the bregma. The frontal region is somewhat acrocephalic. The teeth are poor. No portion of the coronal suture is visible. The lambdoidal suture can be traced in its entire middle portion.

No. 74. Name, Fanny G. Age, 48 years. Sex, female. Height, 5 feet 7½ inches. Weight, 144 pounds. Physical condition, excellent. Clinical diagnosis, homosexual. Descriptive observation: The bones are of average thickness though uneven. There is a bare scaphocephalic depression at the vertex and a rickety ridge at the lambda. The coronal suture is not visualized. Only the middle portion of the lambdoidal suture can be traced. The jaw is practically edentulous, both upper and lower.

No. 75. Name, Elsie B. Age, 50 years. Sex, female. Height, (?). Weight, 118 pounds. Physical condition, good. Clinical diagnosis, maniac depressive. Descriptive observation: The bones are somewhat thicker than average normal, porotic and eburnated on their inner surface. No part of the coronal suture can be seen: and the lambdoidal suture is practically entirely occluded, the course being occasionally indicated. The teeth are good.

No. 76. Name, Fannie R. Age, 35 years. Sex, female. Height, 5 feet 2 inches. Weight, 120 pounds. Physical condition, poor. Clinical diagnosis, maniac depressive. Descriptive ob-

servation: (There is no film in this case).

No. 77. Name, Blanche W. Age, 47 years. Sex, female. Height, 5 feet 6 inches. Weight, 159 pounds. Physical condition, good. Clinical diagnosis, undifferentiated psychosis. Descriptive observation: The bones are of average thickness. Neither the coronal nor the lambdoidal suture can be traced. The teeth are poor.

No. 78. Name, Teresa G. Age, 59 years. Sex, female. Height, 5 feet 3 inches. Weight, 111 pounds. Physical condition, good. Clinical diagnosis, maniac depressive insanity. Descriptive observation: The bones are thin anteriorly and thick posteriorly. There is a general osteoporosis probably incident to age. All of the teeth are missing. Neither the coronal nor the lambdoidal suture can be seen.

No. 79. Name, Harriett S. Age, 58 years. Sex, female. Height, 5 feet 5 inches. Weight, 150 pounds. Physical condition, good. Clinical diagnosis, constitutional psycopath. Descriptive observation: The bones are of average thickness. The subject is practically edentulous. The film is too poor to interpret.

No. 80. Name, Grizell B. Age, 55 years. Sex, female. Height, 5 feet 8 inches. Weight, 110 pounds. Physical condition, good. Clinical diagnosis, (?). Descriptive observation: The bones are of average thickness and irregular on the inner surface. There is an area of osteoporosity at the endobregma. The coronal suture cannot be traced. Only occasional portions of the lambdoidal suture can be seen. All of the teeth are missing.

No. 81. Name, May W. Age, 47 years. Sex, female. Height, 5 feet 4 inches. Weight, 119½ pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are thicker than average normal. No portion of the coronal suture can be seen. The middle portion of the lambdoidal suture is plain though straightened. The teeth are good. The head tends to scaphocephaly.

No. 82. Name, Margaret G. Age, 41 years. Sex, female. Height, 5 feet 3 inches. Weight, 97 pounds. Physical condition, good. Clinical diagnosis, undifferentiated psychosis. Descriptive observation: The bones are of average thickness. The head is dominantly brachycephalic and well rounded. Only a portion of the lambdoidal suture can be traced. The teeth are poor.

No. 83. (No clinical record nor film in this case.)

No. 84. Name, Amy B. Age, 51 years. Sex, female. Height, 5 feet 4½ inches. Weight, 112 pounds. Physical condition, good. Clinical diagnosis, pre-senile psychosis. Descriptive observation: The bones are of average thickness. The middle portion of the coronal suture can be traced, as can also parts of the middle portion of the lambdoidal suture. The teeth are bad.

No. 85. Name, Annie A. Age, 48 years. Sex, female. Height, 5 feet 5½ inches. Weight, 121 pounds. Physical condition, good. Clinical diagnosis, hysteria. Descriptive observation: The bones are of average thickness. Neither the coronal nor lambdoidal suture can be seen. The teeth are poor. The head tends to a moderate scaphocephaly, deepening at the vertex.

No. 86. Name, Julia M. Age, 23 years. Sex, female. Height, 5 feet 1¾ inches. Weight, 103 pounds. Physical condition, good. Clinical diagnosis, undifferentiated psychosis. Descriptive observation: The bones are of average thickness anteriorly but much thickened posteriorly. They are irregular on the inner surface. There is evidence of pressure erosion at the frontal sagittal region. The coronal suture can not be traced. The lambdoidal suture is everywhere plain. Excellent teeth. There is a straight line from the occipital protuberance to the menton.

No. 87. Name, Bertha S. Age, 44 years. Sex, female. Height, 4 feet 11¾ inches. Weight 136 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are of average thickness. Very marked arterial ducts are observed from the post bregma downward and anteriorly. No part of the coronal suture can be seen. Only an occasional portion of the middle portion of the lambdoidal suture is visualized. The subject is practically edentulous.

No. 88. Name, Kate M. Age, 48 years. Sex, female. Height, 5 feet 3 inches. Weight, 107 pounds. Physical condition, poor. Clinical diagnosis, paranoid dementia praecox. Descriptive observation: The bones are somewhat thicker than usual. The middle portion of the coronal suture and practically the entire lambdoidal suture are clearly visible. Only a very small frontal sinus is observed. The teeth are in poor condition, many missing, and the rest carious. There is no evidence of pathologic sutural synostosis.

No. 89. Name, Myrian H. Age 30 years. Sex, female. Height, 5 feet 0 inches. Weight, 117 pounds. Physical condition, good. Clinical diagnosis, dementia praecox. Descriptive observation: The bones are of average thickness in front but somewhat thicker than normal posteriorly. There is a rickety ridge at the lambda. The head is brachycephalic. The middle portion of the coronal suture can barely be visualized. The lambdoidal suture is plainly seen. The teeth are good. There is an absence of frontal sinus though a slight superciliary ridge.

No. 90. Name, Adelaide H. Age, 58 years. Sex, female. Height, 5 feet 1½ inches. Weight, 115 pounds. Physical condition, poor. Clinical diagnosis, catatonic dementia praecox. Descriptive observation: The bones are markedly osteoporotic with eburnated internal surfaces. The head is dominantly brachycephalic. There is a straight line from the occipital protuberance to the menton. The middle portion of the coronal suture can be seen, as can also the middle portion of the lambdoidal. The teeth are good.

No. 91. (No clinical record given of case.) Descriptive observation: The bones are of average thickness. Both jaws are edentulous. No sutures are observed. There is no clinical record of this case. The extremely thin lower jaw and the total occlusion of sutures suggests old age.

No. 92. Name, Elizabeth G. Age, 48 years. Sex, female. Height, 5 feet 1½ inches. Weight, 104 pounds. Physical condition, good. Clinical diagnosis, undifferentiated psychosis. Descriptive observation: The bones are of average thickness. There is an occipital bulge. The coronal suture can not be seen. The middle portion of the lambdoidal suture is visualized. The teeth are fair.

No. 93. Name, Amelia T. Age, 50 years. Sex, female. Height, 5 feet 7 inches. Weight, 135 pounds. Physical condition, poor. Clinical diagnosis, epilepsy. Descriptive observation: The bones are thicker than normal. The cranium is preponderantly large in relation to the face. The middle portion of the lambdoidal suture can be traced. Many teeth are missing. There is a tendency to scaphocephaly.

No. 94. Name, Mattie H. Age, 51 years. Sex, female. Height, 5 feet 3 inches. Weight, 115 pounds. Physical condition, poor. Clinical diagnosis, epilepsy. Descriptive observation: The bones are of average thickness. The sutures can not be differentiated. The teeth are poor.

No. 95. Name, Blanche N. Age, 15 years. Sex, female. Height, 5 feet 4 inches. Weight, 125 pounds. Physical condition, good. Clinical observation, epilepsy. Descriptive observation: The bones are thin anterior to the bregma and somewhat thicker posteriorly. The lambdoidal suture can

barely be traced. The teeth are excellent.

No. 96. Name J. D. L. Age, 27 years. Sex, male. Height, 5 feet 2 inches. Weight, 133 pounds. Physical condition, good. Clinical diagnosis, (?). Descriptive observation: The bones are of average thickness, though everywhere osteoporotic. The middle portion of the coronal suture can be seen. The entire lambdoidal suture can be visualized. The teeth are excellent.

No. 97. Name, Ethel T. Age, 41 years. Sex, female. Height, 5 feet $4\frac{3}{4}$ inches. Weight $113\frac{1}{2}$ pounds. Physical condition, good. Clinical diagnosis, epilepsy. Descriptive observation: The bones are of average thickness. The middle portion of the coronal suture and a part of the lambdoidal suture are visible. The teeth are good. There is no evidence of abnormal synostosis. A marked prognathism involves the superior and inferior jaw bones. The frontal sinuses are absent. The frontal region shows some pressure burrowing.

Objections to the Use of "One Lethal Dose" Method in Malignancy

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LOOK, if you please, at the medical lore of the last ten years. You see this statement: "The lethal dose should be given at one sitting", or, "If it is not practicable to give the entire dose at one sitting, it should be giv n in as short a time as possible."

These statements, with a ringing in of slight variations, have been repeated until it would seem that, convinced by reason of this very repetition, many have commenced to believe them. . . .

It is the purpose of this paper to take issue with this dictum and to show from the writings and experience of the profession that the use of the term "one lethal dose" is unscientific and illogical.

There are two theories as to the effects of x-rays on cancer cells. The "lethal dose group", if we may so call it, believes that the cell is killed by direct action of the ray, acting more efficiently perhaps, when the cell is in active karyokinesis. The other group holds that the death of the cell is secondary, being brought about largely by the vascular changes induced by the treatment. These changes in the blood and blood vessels allow the cells to starve, as it were.

The writer believes that both elements enter into the death of the cell, but that the action on the supporting tissue and blood is of more importance than the effect on the cell itself.

Caspary, as quoted by Levin[1], has reported success in preventing cancer inoculations by previous raying of the site of the inoculation with small doses of x-rays. Levin goes on to state: "All the experiences related confirm that in the fight against cancer we must stimulate the organism as a whole in addition to our local measures." His experiments indicate that the leucocytes and lymphocytes are active agents in this induced immunity.

The experiments of Murphy and Hussey[2] showed that heavy x-ray exposure for two hours on one-half of a tumor from a mouse made practically no difference in the number of takes after inoculation as compared with inoculations of the half of the tumor not thus treated. Furthermore, grafts from a non-radiated tumor placed on different areas of the same mouse failed to grow only when the area of inoculation had received previous radiation. The same results were not obtained in deep tissues.

These experiments demonstrate well that simple exposure of cancer cells to x-rays in accordance with a set of formulae devised by Seitz and Wintz, or anyone else, is insufficient as a method for the cure of cancer.

Now, turning to those who depend on the effect of the rays on the supporting tissues, Ewing states:

> "1. When a practioner possessing a small amount of radium applies it to a rodent ulcer in repeated small doses over a period of weeks he usually observes the disappearance of the tumor and very often it never recurs. Meantime, the skin shows little reaction and the scar is small or absent. Exactly what he has done no one knows, but he has not killed any cancer cells. Sections taken at intervals through tissue so treated show hyperchromatism of nuclei and hydropic swelling of tumor cell bodies followed by gradual atrophy of the cells. At the same time the surrounding tissues become active, leucocytes emigrate, lymphocytes and plasma cells appear, capillaries proliferate and all these invade and replace the tumor mass. A slow, regressive process with degeneration of tumor cells, and a progressive process with exudation and proliferation of normal tissues are set going, and as a result of these processes the tumor is cured.
>
> "2. When larger amounts of silver-filtered radium are used the same course of events is observed. Some superficial tumor cells may suffer immediate necrosis, but tissue sections show that the bulk of the tumor is removed by a very rich exudate of lymphocytes and plasma cells and by active growth of new capillaries which surround and compress much of the deeper parts and mechanically extrude the outer layers of the degenerating tumor cells. In many cases of this type I have failed to find many killed or necrotic cells, but have been able to trace all stages of the atrophy of degenerating tumor cells in the mass of reacting proliferating tissue. It is clear that the reaction of the tissue is an essential factor in the curative process. Under some circumstances, when this reaction fails, no amount of radiation succeeds in killing the tumor cells. I have seen recurrent rodent ulcer very heavily radiated, with necrotic stroma tissue, supporting well stained and apparently viable tumor cells. Every radiologist is familiar with these indolent reactionless cancerous ulcers which resist all efforts at cure and have to be excised or burned out.
>
> "The simple morphological interpretation of the changes reveals the highly important fact that in treating cancer by physical agents we are not merely killing cancer cells, in the sense of the physicist, nor extirpating it entirely, according to the surgeon's plan, but rather are calling upon Nature's forces to accomplish the cure. On this account we may assert that physical

* Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 6, 1922.

therapy, although still lacking some essential elements of an ideal method, is, to some extent, a rational therapy of cancer as far as we know the disease."

This statement is the clearest and most convincing that has appeared in the literature and if taken seriously would indicate not only that to try to give a lethal dose at one sitting would not be advisable, but, on the contrary, such a course would be going contrary to all of our knowledge as gained from the microscopic study of irradiated tissues. Such a course also would be going against common custom in the matter of dosage as practised not only by the more conservative followers of the divided dose method, but also, as will later be shown, contrary to the common practise of those who advocate the "lethal dose" in their published writings.

The tissue changes as described are so in accord with the common experience of those employing radiation that they cannot fail to bear the imprint of truth. Many writers profess a belief in the "lethal dose", but their writings contradict themselves. In most cases, their own technique belies their writings. Take Pfahler, for instance. In an article on radiotherapy in carcinoma of the breast, he says, "theoretically it would be desirable to give a massive dose of radiation over the mammary region and the glandular areas leading therefrom at a single massive dose."

Now, what we desire to bring out is that theoretically giving such a massive dose would be the height of folly. To prove our contention we only need to read further in the same article the technique of the author himself to find that he thinks so too:

> "Each application is the equivalent of two-thirds of an erythema dose. Each of the areas is treated again during the second week so that the second radiation over each area is given a week from the first and each of the three areas receives two of these treatments within a period of two weeks. In other words, one and one-third erythema dose of deep radiation is given within a period of two weeks. If one adds to the direct action of the rays to these areas the secondary effect from the treatment through the other two areas, we must conclude that we are probably getting during this first two weeks apparently two erythema doses which is more radiation than could possibly be carried into the tissues by any other method. Some one may criticise this technique because a full erythema does is not carried into each of these fields immediately, but by such process one would probably produce dermatitis and would certainly not be able to give more than half the amount of radiation within a period of a month. This technique has been developed after much experience, but will probably be modified in the near future."

The purpose of the writer is not to give a long, drawn out, hairsplitting, ultrascientific dissertation which begins at zero and ends at infinity, but it is to bring out a few salient points which have been evolved from the experience of the large number of x-ray workers in this country especially. When these experiences and facts have been weighed and analyzed we try to shape our course toward further advancement in the treatment of malignant disease.

We shall not in this article dwell on the necessity of proper distance, proper screening and proper use of various portals of entry to get the greatest proportion of rays into the area to be effected.

An article by Hirsch[1] is the best analysis that has come to our notice of the various factors that enter into the proper treatment of malignant disease. One paragraph will be of interest: "The technique of successful radiation of cancer demands: (1) A radiation of the proper quality and quantity. (2) The administration of the lethal dose of this radiation to all the cancer cells at the varying depths at which they exist. (3) The administration of the dose in such a way that, (a) the local resistive power of the normal cells about the tumor is not depressed and, (b) the general resistance of the whole organism is not appreciably lowered."

Factors that have not been mentioned which produce important limitations in the application of treatment are: radiation sickness, leukocytosis (following radiation), stimulation of growth by too small doses of x-ray and necrosis from too much ray.

Concerning radiation sickness Narat[2] says:

> "The application of the roentgen rays to any considerable portion of the body causes a tremendous increase in the destructive metamorphosis of tissue. The effect under consideration is not that of a toxic dose, but that of a single therapeutic application. This calls for increased activity of the aliminative organs. The cases in which this increased destruction of the tissues is likely to produce a harmful effect are those in which there is already a disturbance in elimination of waste products, as in nephritis, congestion of the kidneys, cirrhotic kidneys or those in which the patient suffers from toxemia of cancer, pernicious anemia, leukemia or similar diseases.
>
> "As far as the unfavorable effect of irradiation on the different organs is concerned, there is practically no possibility of any specific after-treatment. The prophylaxis, consisting of a careful protection of the body from the roentgen rays with the exception of the area to be exposed, is the most important factor. It is sometimes extremely difficult to combat the roentgen toxemia. A careful observation of the patients after a roentgen ray treatment proves in many instances that this toxemia is not to be neglected, as it commonly occurs. Irreversible changes in the blood, a real roentgen cachexia, can cause a premature death. Though it is very vital to administer a lethal cancer dose at the first attack, a reckless irradiation is not justified and we would not do the patient a great favor in killing at the same time the cancer and its carrier."

It is well established that the leukocytosis which follows x-ray is an important factor in the cure of cancer. Overdosage causes a more or less permanent reduction of the leukocytes.

On the other hand, it is well held and seems to be borne out by experience that too small doses of rays of tube or radium often tend to stimulation. Let us assume for the sake of argument that this theory has been proved, that we may clear the way, after considering all of the factors involved, for a comprehensive view of the method of treatment that will give the best results.

Our treatment must avoid, first, radiation sickness and severe blood changes; second, too severe local reactions. It must produce the utmost reaction of the supporting tissues. It must be repeated as often as this maximum reaction can be produced.

You will note, if you will recall the dicta of Hirsch, that the conclusions here drawn are practically the same as those quoted from his able article. Still more remarkable is the fact that the technique, as developed empirically by the writer, is almost identical with that mentioned by Pfahler.

What, then, is the point at issue if men experienced in the use of the x-rays develop a nearly uniform technique? Why worry if one group talks of the "one lethal dose", while the other talks of developing an immunity to cancer? Will not the difference be as immaterial as the differ-

ence between the Republican and Democratic parties?

I say: "No". While quinine has always been of value in malaria, it is only since the relation of the life cycle of the plasmodium to the disease has been thoroughly understood that really scientific therapy has been adopted.

Again, true progress can be made in treatment of cancer only when our treatment is based on a knowledge of pathology. It would certainly be fine if all there were to curing cancers were to consider the cell to be killed, its distance, its depth, its type, then take a slide-rule and set it at the point marked "cure". An x-ray machine set in accordance with the adjustment indicated would cure the case. This sounds extreme, but it is what some of our German friends would have us believe. It reminds us of some other German conclusions drawn as the result of pure mathematics.

The problem we are facing is the old one of assisting the human body in the fight against disease. The x-ray stimulates and assists the body in the fight against cancer. It does not kill the cancer.

Just a closing word as to the reason for this paper. It was not written that the experienced men should change their methods, for, as has been shown, men who understand radiology and its limitations develop their technique in accordance with said limitations. It was thought, however, that a paper of this sort might be of assistance to the beginner in radiology or the man who does but a moderate amount of work and who trusts to the directions of the salesman of the machine and the gleanings from the literature for his information as to dosage and technique. Such an one might easily fall into serious error were he to follow the trend of thought as indicated in the literature of the last few years. To such an one I say: Do not take the writings of all the experts too seriously. Follow their practice, not their theories.

To those who observe, cases like the following are familiar: A patient for whom a line of treatment, such as has been mentioned, has been prescribed, looks around a little and decides to go to the x-ray man across the street who gives massive doses. The so-called "massive dose artist", beneath his bold exterior being of a timid and law-avoiding disposition, gives a massive (?) two-thirds erythema dose. The patient is assured that he has had sufficient treatment for six weeks. In six weeks this process is repeated. In ten weeks he returns to the divided massive dose man who finds that the treatment has been just sufficient to fan the flame and the patient is worse off than if no treatment had been given.

Again, a patient has been given sufficient radium to care for the local condition in carcinoma of the cervix. She is receiving the maximum of x-ray, front, back and laterally, that conditions permit. The ultimate outlook is unfavorable, but the patient is comfortable and happy, no odor, no pain, no discharge. Lacking assurance that the patient is cured, the husband sees in the daily papers that Dr. X in a neighboring city has secured one of a new type of x-ray machines giving a voltage that is phenomenal. (Incidentally, there are few such machines in the state, or country, as the case may be). The husband notices that it is *hoped* that this machine will revolutionize the treatment of cancer. The wife, already saturated with treatment, is hurried to the city and given a twelve hour treatment, heavily filtered, with the new wonderful machine. She is taken home deathly sick and for the few remaining weeks of her life suffers radiation sickness and cachexia,—the immediate cause of death being too much ray.

To conclude: the cancer cell is not killed by "one lethal dose" only, but largely by the action on the supporting tissues. The proper dosage is one that stimulates the supporting tissues to the utmost, arouses only a mild negative reaction and decrease of leukocytes, and avoids severe general radiation sickness. This dose should be repeated as often as conditions will permit for a period varying in length in proportion to the size and nature of the lesion to be eradicated.

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EDITORIAL

The JOURNAL OF RADIOLOGY

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ANNUAL MEETING
Rochester, Minnesota
December 3, 4, 5, 6 and 7, 1923

American College of Radiology and Physiotherapy

WHAT is undoubtedly a very significant development in the field of radiology and physiotherapy occurred in Omaha on September 18th, 1923, when the American College of Radiology and Physiotherapy was organized. There has long been great need for a parent organization for the purpose of coordinating the activities of the numerous organizations dealing with these branches of medical science, and for the development of these sciences by affording those members of the medical profession interested therein some place to go for authentic information with respect to physics, technique, etc. That this is the purpose of the present organization will be acknowledged when it is known that the American College of Radiology and Physiotherapy is modeled after the American College of Surgeons and the American College of Physicians.

The organization of the American College of Radiology and Physiotherapy is the logical result of the action taken by the American Medical Association at its latest annual meeting in San Francisco. The following excerpt is taken from the minutes of the A. M. A., as reported in its journal:

> "We feel, however, that the Association should recognize the increasing importance of special medical activities, such as radiology, physiotherapy, and occupational therapy, * * * and we recommend that the American Medical Association recognize the science of radiology as an integral part of medicine and surgery."

Having previously been accorded recognition by the American College of Physicians and the American College of Surgeons, the action thus taken by the American Medical Association completes recognition of the science by the three organizations which constitute the great triumvirate of medical science in the world.

Briefly, the purposes of the American College of Radiology and Physiotherapy, as stated in its constitution, are to elevate the standard of radiology and physiotherapy, to establish a standard of competency and of character for practitioners of radiology and physiotherapy, to provide a method of granting fellowships in the organization, and to educate the public, technicians, and the profession to understand that the practice of radiology and physiotherapy calls for special training and that the physicians elected to fellowship in the College have had such training and are properly qualified to practice radiology and physiotherapy.

It is the purpose of the College to preserve the identity of those organizations and societies already existing in these two phases of medical science and to encourage the formation of others. The College expects to function most happily in acting as a sort of clearing house, to which all other organizations may send delegates at the time of annual sessions and work out constructive policies and programs designed to advance the interest of the science in question and forward the utmost spirit of good will and fellowship among the various organizations upon these subjects, as well as between these organizations and the medical profession as a whole.

The following organizations have already received recognition by the College:

(1) The American Electrotherapeutical Association.
(2) The American Radium Society.
(3) The American Roentgen Ray Society.
(4) The Canadian Radiological Society.
(5) The Radiological Society of North America.
(6) The Central Electrotherapeutic Society.
(7) The Central Illinois Radiological Society.
(8) The Chicago Roentgen Ray Society.
(9) The Detroit Radium and X-Ray Society.
(10) The Iowa State Radiological and Physiotherapy Society.
(11) The Iowa X-Ray Club.
(12) The Missouri Radiological Society.
(13) The Nebraska Society of Radiology and Physiotherapy.
(14) The New England Association for Physical Therapeutics.
(15) The New England Roentgen Ray Society.
(16) The New York Electrotherapeutic Society.
(17) The New York Roentgen Ray Society.
(18) The Pacific Coast Roentgen Ray Society.
(19) The Philadelphia Roentgen Ray Society.
(20) The Roentgen Ray Society of Central Pennsylvania.
(21) The South Dakota Radiological and Physiotherapy Society.
(22) The Utah Society of Radiology and Physiotherapy.
(23) The Western Electrotherapeutic Association.
(24) The Milwaukee X-Ray Club.
(25) The American Physical Society.
(26) American Society of Dental Radiographers.

Similar recognition will be accorded other like organizations upon the presentation of appropriate credentials.

The officers of the College elected at the organizational meeting are:

Samuel Beresford Childs, M. D., Denver......President
E. A. Merritt, M. D., Washington, D. C. . President-Elect
B. B. Grover, M. D., Colorado Springs. . First Vice-Pres.
Roy W. Fouts, M. D., Omaha......Secretary-Treasurer

Officered by such eminent men and having an initial membership running into the hundreds, the success of the American College of Radiology and Physiotherapy is at once assured. That it will rapidly prove its force for good

in the science of medicine along the lines of its organization can hardly be denied.

Every reputable physician or surgeon interested in these branches of medical science will find in the College a mecca of men of like interest, high-minded in their purpose, and zealous in upholding the high ideals and dignity of their profession.

Presidential Address

C. L. Mullins, M. D., Broken Bow, Nebraska

IN OUR AGE peoples everywhere are struggling toward organized effort, trying to combine the forces working along similar lines for the accomplishment of definite purposes.

Commercial enterprises found it advantageous and necessary to organize their business down to the minutest detail and now these separate commercial enterprises working along similar lines are combining and working in harmony and a spirit of cooperation as a matter of economy and efficiency. This, to the writer, seems wise, and he believes that ultimately it will be to the advantage of mankind.

The pioneers in medicine in this country felt the need of organized effort, and through their efforts the first organized medical societies in this country were achieved, and out of these scattered and disconnected medical societies ultimately grew our great American Medical Association. Who can doubt that that Association with its organized ramifications extending to the different counties of the different states has been a benefit to mankind? Has it not furthered the cause of medical education, of scientific medicine, and of public health work in innumerable ways? Today it would be impossible for any one to fully estimate its benefits to the people of this country. In the effort at reorganization of the American Medical Association the writer had an humble but active part, and his sympathy was and is with that effort.

Then, why, with this great organized body of medical men and women is the effort now and here being made to organize a separate, unattached society? The answer is easily found: The large and growing subject of radiology is comparatively new and I believe it a conservative statement that outside of radiography and fluoroscopy but few physicians understand the benefits it may bring to a large class of disease conditions. Comparatively few have followed the development of the x-ray, for instance. Probably few, except the radiologists, know about the modern Coolidge tube and how it enables the user to standardize the dose and to avail himself of the higher voltages, with immense benefits resulting to the victim of disease conditions.

The field of physiotherapy is new to many of you now just engaging in the work, and the modern methods are new to all, due to the great improvement made in recent times in the machinery used by the physiotherapist. That the radiologist and the physiotherapist can and does bring to bear in the treatment of disease conditions measures of very great value, measures not used by the great majority of physicians, you who have had a well observed experience can testify.

It is the province of this society to spread the knowledge of these measures, not only among its own members, but to physicians everywhere. If these methods of treatment are useful, and we believe that they are, the afflicted everywhere should have the benefits of such treatment where indicated. There is no antagonism as between this society and the American Medical Association and its integral parts. For the present, and probably for some years to come, there is and will be need of such special societies working along these special lines.

The time may come, but has not yet arrived, when workers along these lines will find a section in their respective state medical societies. While awaiting this desirable condition idleness is worse than wasteful. There is a useful work to be done. Papers should be read before the regular state and county society meetings by workers in the field of physiotherapy and thus bring forcefully before the general medical man the character of the work being done.

The physician and the surgeon, with the methods pursued now and in the past, have achieved some very wonderful results, but every physician of experience has realized many many disappointments in his endeavors to relieve, while he faithfully followed the beaten path. One of the great retarding forces in man's progress has been his reluctance to get out of the beaten path, his refusal to adopt new measures or methods of procedure.

It is true that all these methods of treating disease are not entirely new, for there have been earnest workers in this field for many years and all honor to these men who by their science, patience and hard work have made the present possible. It is now the duty of you who are working in this field with vastly improved machinery and better methods to carry this knowledge to your fellow physicians. This will be an easier task for you than was that of the pioneers in this field in bringing to you the present satisfactory conditions in physiotherapy and radiology.

In recent years we have seen a deluge of cults and isms spring into being. Some have flourished for a time and then faded away, while others made an appearance. What is the reason, how account for this condition of multiple cults? The main reason seems to be that people patronize them. The question as to why people patronize them seems pertinent.

There is a large class of diseases or disease conditions not benefited, or but little benefited, by methods heretofore used by the physician, and many of these condition are not amenable to surgery. Such patients make the rounds of the physicians and finally many of them fall into the hands of practitioners of one or other of these cults, where they are encouraged to believe that they will be made whole. True, many of them ultimately return to the physician often to his discomfiture. A large number of these diseases and disease conditions can be benefited and many can be cured by the methods of the radiologist and physiotherapist. If the physician is not willing to give of his time and intellect to these sufferers he should not complain if they seek out irregular practitioners. I have heard it said in no friendly spirit that these methods attract a swarm of chronics. This is largely true. Are they not entitled to health, and if that be not possible of attainment, as near health as possible? For such help as you give them they are the most grateful of patients, doubtless because they have suffered for long periods of time. It is a pity, and worse, for the regular practitioner to neglect these perfectly proper and useful measures, for, although in neglecting such means he is cheating himself, the greater loser is the patient.

One of the greatest needs of this work now is a larger literature, text books grounded in science and based upon a well observed experience and complete in the details of technique so that the beginner may have at hand the means to properly direct him in his early efforts. General statements and even elucidation of principles are not sufficient. The technique of application is the most difficult part of the work to learn. The same modality used a little differently often gets results opposite in character. Good journals in this as in other branches of medicine are a necessity and it seems to the writer that good active societies where workers come and exchange ideas and experiences are even more needed than in other fields of medical endeavor. A good

medical society meeting is the best school of instruction. The society is of especial help to the new recruit and he cannot afford to remain on the outside, and his patients can still less afford his maintaining an attitude of aloofness from the society.

In the improvement of the machinery with which we work we have a vital interest. I feel that it should be considered a privilege to work in cooperation with the manufacturer of the devices and machines used towards their improvement. I am confident that all reputable manufacturers will welcome suggestions and be pleased to have your cooperation. In such improvement we have a very real interest. With the manufacturer who puts out a pocket edition and loudly proclaims a cure-all we have nothing in common. Probably some of us have expected too much of the salesmen and the men who install these machines. The most we should expect of these men is a proper installation and the acquisition of a working knowledge of its mechanism. They are not physicians.

I hope it will not be considered remiss to direct the attention of beginners and prospective purchasers of these devices to a point the writer considers important. Beware of pocket editions. The best machine, at whatever initial cost, will prove the cheapest and the most satisfactory. After getting the best the user should take plenty of time to work out the problem at hand before attempting treatment. To allow ones self to be hurried at this stage of his work is to make mistakes, his efforts are likely to be worse than fruitless. The worker must not forget that he has no miracle performing apparatus and that he must still use his knowledge of pathology, diagnosis, etc., as before, and he still has the task of working out just what method of treatment is best suited to the case. We all know that there are many people who still are looking for miracles, and if the beginner allows himself to be hurried by those impatient of results nothing but a miracle will get results for him.

Nothing but close study and hard work will bring a working knowledge of these methods of treatment, just as in other branches of medical treatment. These methods do not offer an easy road to successful treatment, but if one is willing to intelligently study out the problem at hand they do offer a successful method of treatment of many diseases not amenable to the methods with which many of us have had, heretofore, to be content The practitioner who is thinking only of his personal gain, regardless of results, can bring nothing but disrepute upon himself, and his methods hurt the work of the honest worker. He should find no place in this society. A few such individuals on the inside will kill a good society.

If by mischance we find the charlatan in our society he should be summarily cast out. To all honorable physicians the society extends a cordial welcome to its roster of membership. We need them and they need the society. The field is large enough to challenge the best intellects.

With the improvements constantly being made by manufacturers and the increasing knowledge of these methods and their usefulness, with better methods coming into use by the radiologist and physiotherapist the field constantly widens and becomes increasingly interesting. It seems peculiarly fitting that the radiologist and physiotherapist should join forces as they have done in this society. X-ray, radium, actinic ray and the other methods and modalities used by the physiotherapist are often synergistic, often supplementary to each other in the treatment of disease. The user of one modality will, more and more, become the user of all.

To the members of this society I desire to express my sincere appreciation of the honor you conferred upon me and the confidence you reposed in me by electing me your first president. As a token of my appreciation I shall in the future years work for the upbuilding and usefulness of this society, useful alike to the physician and to those who suffer from disease.

The Late John M. Siddall

THE PHENOMENAL success of the late John M. Siddall, editor of the American Magazine, may be summed up in the fact that he realized the value of a constructive program. He laid great emphasis upon the personal appeal and the helpfulness of the cheerful aspects of existence. He hated muckrakers with the most bitter hatred. This point is interesting, too ,for early in his literary career he was himself a muckraker. He helped Ida M. Tarbell collect the material used in her history of the Standard Oil Company—the book chiefly responsible for the avalanche of anti-business and anti-corporation writing characteristic of the magazines of that time. Mr. Siddall's change to the opposite viewpoint was evidently one of evolution. He took hold of the American Magazine when it was of mediocre reputation and made it the leader in its field. His emphasis of the better things in life and his stress upon the attributes of success built up the circulation from 400 000 to approximately 2,000.000. Could any better evidence of his greatness in the editorial field be found?

Success in the field occupied by the late John Siddall is no different in its underlying principles than success in the medical field. The Journal of the American Medical Association has attained a success never before thought possible in medical journalism. For the reason for this success one must point to the man who conceived the idea and carried it through to fruition as editor, Dr. George H. Simmons.

There is no reason why the Journal of Radiology cannot fill its field with equal success. Cooperative, constructive effort has made the Journal what it is today, and if continued will build even greater on the foundation which has already been laid.

Abracadabra

ABRACADABRA! said The Little Lame Prince, and he was off and away to all his heart's desires in a jiffy, traveling on his magic carpet, no, it was a cloak. Have you forgotten him? Well, he did, just the same.

A woman, this summer, lay dying in a London hospital. She knew her fate, that she was soon to die, and she yearned that she might pass out over her own threshold. But she was a Belgian woman and "home" was two hundred miles away, in Brussels— and so she died in London tormented with the homesickness of the stranger who dies in a strange land—Ah, no! Not in this, the Age of Wonders, when even Death sometimes stops to stare a moment, surprised at the doings of the earth children. For, as the *Manchester Guardian Weekly* tells us, by the magic of twentieth century genius this homesick, dying woman reached her home in Brussels within just one hundred minutes from the time the air plane left London. She was taken in an ambulance to the London air station at Croyden, lifted upon the stretcher to a comfortable bed in one of the eleven passenger Napier D. H. 34 planes of the Instone line, which had been converted into a flying ambulance. The 450 horse power engine had been silenced and in absolute comfort the dying patient reached her loved home, there to await the swifter journey in the silent plane that one day calls for each of us to mount and away to the Great Adventure—the adventure that Frohman, awaiting it upon the Lusitania, calmly designated as the most beautiful adventure in life.

We wonder will some later comer to this globe, some day centuries hence, take from a library shelf an old bound

magazine and read on a faded page this account, smiling amusedly to himself at the simple people of that Early Twentieth Century who were so amazed at their, to him, small achievements? Or will he muse on us as now do we upon the genius of the old builders and artists, and wish for his own age a fuller measure of something then lacking in the world?

Physiotherapy Meeting

INTEREST in the subject of physiotherapy among reputable medical practitioners has become so pronounced that H. G. Fischer and Company, of Chicago, has arranged for an extensive program during the month of October. Full details will be found in the announcement which appears over the Fischer Company's signature on the page facing the last reading page.

It will be borne in mind that this meeting is given strictly by medical men for medical men and is open to any reputable member of the profession. Already nearly 500 reservations have been made.

Mr. H. G. Fischer is authority for the statement that those in attendance will be absolutely free from commercial influence or suggestion and that this is merely that company's bit toward the development of a phase of medical science which has been in times past somewhat in disrepute.

The Journal is of the opinion that if the reputable members of the profession will put physiotherapeutic methods under their supervision and work in this field from the inside out rather than the outside in, any stigma now attaching will shortly be removed. That there is much merit in physiotherapy in selected cases is amply proven by the names of

Fifth Italian Congress of Radiology

THIS CONGRESS will be held at Palerno on October 18th to 21st, 1923. Prof. O. M. Corbini and H. E. Senatore Giovanni Gentile are members of the committee under whose auspices the meeting is being planned. Particulars can be obtained from the secretary, Dott. Sigroli Salvatore, Via Alloro, 58 Palerno, Italy.

DEPARTMENT of TECHNIQUE

Rapid Preparation of Developing Solutions

E. G. C. WILLIAMS, M. D.
Danville, Illinois

PREPARED or package developers are very convenient, but are an expensive luxury where tank developing is used. Developing solution can be prepared from bulk chemicals with but very little trouble when the process is simplified and a few time saving accessories are used.

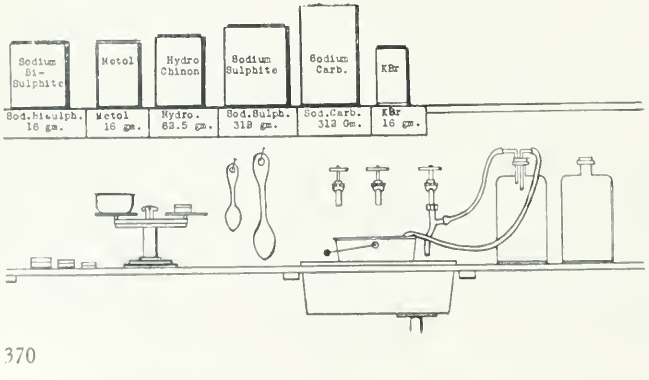
There is no reason for experimenting with different formulas each time the solutions are prepared. The formula we are using now has been in use eight years, is thoroughly satisfactory, and was much less expensive than package developers during the war period, when metol was very costly and hard to find.

The quantity made each time is an important factor. Two gallon lots have been found to be most conveniently prepared. Five gallon lots are difficult to make and handle on account of the weight of jars and danger of incomplete solution of the chemicals.

The following formula for two gallons of developer is given to illustrate method of preparation. Any formula can be arranged for this system by changing weights or order of solution.

The illustration diagrams the arrangement of shelf, table and sink for convenient preparation of solution.

Water	2 gallons	9 litres
Sodium Bisulphite	4 drams	16 grams
Metol	4 drams	16 grams
Hydrochinon	2 ounces	62.5 grams
Sodium Sulphite	10 ounces	312 grams
Sodium Carbonate	10 ounces	312 grams
Potassium Bromide	4 drams	16 grams



The bulk chemicals are arranged on the shelf in order of their use and a label with the name of the chemical and the amount to be used is attached to the edge of the shelf under each can. A simple balance scale with a 15 cm. porcelain lined pan and counter weight make most convenient weighing equipment. The counter weight for the pan and the 16, 62.5 and 312 gram weights are made of tin ointment boxes containing sufficient lead scraps or dental film backs to make the proper weights. These weights are easily made and save hunting out numerous small weights for each change. Enameled cooking spoons are used in weighing and stirring.

Fill the two gallon bucket two-thirds full of hot water. Add chemicals in order, being sure each is dissolved before adding the next. When all are dissolved, fill the bucket to the two gallon mark. Solution may be poured directly into the tank or stored in gallon bottles.

An ejector or filter pump facilitates filling bottles and emptying the developing and fixing tank when changing solution. A large bore aluminum pump is best suited to this work, as the brass pumps are soon ruined by the chemicals.

The equipment for this work is inexpensive. At current prices of photographer's chemicals, solution can be made for about forty cents a gallon.

CASE REPORTS

X-Ray Demonstration of Four Months Pregnancy

C. J. JOHANNESSON, M. D.
Walla Walla, Wn.

THE CIRCUMSTANCES in connection with this case are as follows: A woman, aged 22, was referred to me for diagnosis, July 9, 1923. Pregnancy was suspected, but the patient denied any such possibility. External examination of the abdomen revealed only a slight enlargement of the uterus, somewhat palpable upon deep manipulation, otherwise there were no abdominal nor breast symptoms. Menstruation had begun at 14 years of age and had always been regular and normal. The last menstruation was given as April 20, 1923. There was no history of quickening, nausea or vomiting; no edema or leukorrhea, nor any history of hereditary disease. Patient weighed 153 pounds and was a well nourished, healthy, unmarried woman.

The roentgenogram, as here reproduced, showed a clearly outlined flexed fetus in almost a true lateral position. The outline of the skull was distinct and the ossification centers of the spine and long bones of the extremities were visible.

The roentgenogram soon convinced the patient of the positive condition of pregnancy. A few days later I learned that she had induced abortion herself. It was, therefore, impossible to confirm the age of the fetus, but after its removal it was estimated by several physicians to be not more than four months old. Weight was 64 grams and length from top of head to coccygeal region measured 116 mm.

In a recent article by Drs. Stein and Arens of Chicago (Jour. A.M.A., 81:5, July 27, 1923) I find the statement that they have been unable to demonstrate the fetus with regularity before five months and that they are of the conclusion that not until the beginning of the last trimester can the fetus be regularly demonstrated so as to be helpful and convincing from a diagnostic standpoint. In the same article is a reference to Kuegle, who had demonstrated a three months' fetus by the x-ray, however, nothing could be seen in the reproduction.

It is my opinion, in view of experience, that by extremely careful and painstaking technique one can be assured of clear roentgenograms demonstrating a fetus as early as four months. At the present time I have patients under observation with the expectation of securing roentgenograms of fetuses at a much earlier date. For example, a woman, aged 31, was referred to me a few days ago for a differential diagnosis of pregnancy and ovarian cyst. The roentgenogram demonstrated clearly the size and outline of the uterus, approximately the size of a five to six months pregnancy, but no fetal skeleton could be seen, although several roentgenograms were taken. The surgeon was notified that no pregnancy was present corresponding to the size of the uterus and that no ovarian cyst was present, but that the tumor was an enlargement of the uterus (non-pregnant). Thorough investigation revealed that the patient had a "hydatid mole."

In comparing the excellent illustrations by Drs. Stein and Arens in the above mentioned article with the reductions from my film there is found a considerable difference in the size of the fetuses illustrated at six months in that article with the fetus I have demonstrated here. This comparison alone will prove that the roentgenogram I am presenting herewith shows a fetus at a much earlier date than six months.

ABSTRACTS *and* REVIEWS

Surgery and Roentgenology. Charles F. Nassau, M. D., Therapeutic Gazette, 47:465-468, July, 1923.

THIS paper, by Dr. Nassau, who is an assistant professor of surgery in the Jefferson Medical College and who is also surgeon to the Jefferson and Frankford Hospitals, Philadelphia, advocates hearty cooperation between the surgeon and the roentgenologist. There are, it is true, times when the x-ray fails to aid the surgeon as he had hoped it might but it is equally true that there are times when surgery is blind without the aid of the x-ray and therefore the surgeon cannot afford to ignore that aid. Not every roentgenologist is equally skilled as an interpreter and this fact will be found to explain many inconsistencies between x-ray findings and operative findings. This should militate against unskilled roentgenologists but the fact is that it militates against roentgenology itself in the minds of many surgeons.

In malignancies the author advises operation whenever possible. Post-operative and palliative treatment is heartily recommended. However, the author advises against diagnosis by x-ray alone and believes that no roentgenologist should undertake treatment of malignancy unless he and the surgeon have arrived at a joint understanding regarding the case. "There

are circumstances, of course, under which either may work alone, but in the majority of cases the patient benefits by their cooperation.

High Voltage Roentgen Ray Therapy; Conclusions Drawn from the Treatment of Three Hundred Cases. Sherwood Moore, M. D., J. A. M. A. 81:269-274, July 28, 1923.

THE author's conclusions are: "(1) All methods of treatment of malignant disease are in need of critical examination. (2) Such treatment needs better coordination between surgical and radiotherapeutic measures and a better understanding between surgeons and radiotherapists. (3) Patients in the malignant ages should be more closely studied, both in regard to the possible existence of neoplasm and in regard to its extent. (4) Patients with widespread extension and metastases should have less surgery and more radiotherapy. (5) More and closer clinical observation and a better follow-up system is a most urgent need in the management of cancer patients. At present there is a disproportion between the time and energy expended on laboratory and clinical studies of malignant disease, respectively. (6) Every effort should be made to place the treatment of malignant disease on the more rational basis of using the natural resistance of the body to combat the disease. The analogy of the treatment of pulmonary tuberculosis presents itself."

Physiotherapy Technic: A Manual of Applied Physics. By C. M. Sampson, M. D., formerly of the Physiotherapy Service, Walter Reed, U. S. Army General Hospital No. 9 Lakewood N. J., etc., etc. Pp. 443, illus. 85, size 9¼ by 6¼ in. Silk cloth binding. 1923. Price $6.50. C. V. Mosby Co., St. Louis, Mo.

THIS author needs no introduction to those familiar with the literature upon this subject. The book is an attempt to put before the medical profession the truths of physiotherapy as the writer has demonstrated them throughout a long experience in a clinic having a trained personnel of 110 operators giving 2300 treatments daily. The author warns against overenthusiasm but nevertheless believes that the field for the proper administration of these remedies is so large that he will not live to see its boundaries completed.

Striking and conclusive data are submitted. The author says: "Practically every step in the technique given in this book is based upon research both in the laboratory and clinic and the results have been checked both by myself and many others who, probably, could not be accused of being prejudiced in favor of the methods. Not a single technique which failed to stand such checking has been included."

The publishers say: "A simple, practical and proven explanation both of the physics involved in the making and application of the physical remedies by a man that positively knows his book upon this subject. The Sanskrit of electricity has been translated into plain English for the physician."

The proper blending of physical remedies is emphasized throughout; also it is said, "Best results can only be secured by taking advantage of every bit of help it is possible to get from the surgeon, internist and laboratory man—we need their help as much as they need ours—and they will not aid us nor allow us to aid them if we keep them antagonistic."

Aside from its scientific value the book is written in a vigorous, entertaining style and in addition to the usual directions for technique is packed full of practical suggestions garnered during the writer's practice.

The chapter headings are 1. The Absolute Necessity for Proper Technique; 2. Examination of Patient; 3. Classification of Physical Remedies; 4. Forms of Heat; 5. High Frequency—General Considerations; 6. Diathermia; 7. Autocondensation (Direct and Modified Diathermia); 8. Nonvacuum Electrode (Indirect Diathermia); 9. Static Modalities; 10. Actinotherapy; 11. X-Ray Therapy in Nonmalignant Conditions; 12. Ultraviolet and X-Ray as Physiologic Complements in Therapeusis; 13. Treatment of X-Ray Burn; 14. Galvanic and Faradic Currents; 15. Sinusoidal Current; 16. Comparison of Interrupted Galvanic and the Galvanic Sinusoidal Currents; 17. Peripheral Nerve Wounds; 18. Massage; 19. Hydrotherapy; 20. Arthritis; 21. Locomotor Ataxia; 22. Pyorrhea Alveolaris; 23. Genito-urinary Conditions; 24. Hay Fever; 25. Trouble Shooting; 26. Adapting Physiotherapy to Private Practice of General Hospitals; 27. A Few General Considerations; 28. Definitions.

Late Lesions of the Larynx Following Irradiation. Otto Juengling, M. D., Strahlentherapie, 15; No. 1, 1923.

THE author distinguishes three reactions following irradiation of the larnyx with deep doses:

1. *The Early Reaction:* With the technique of 100 per cent USD applied to the lesion through two converging fields an early reaction with edema was expected, similar to that observed in irradiation of submaxillary and submental regions. The tracheotomy apparatus was kept ready for use. But no edema occurred. There was enlargement of the submaxillary and submental glands and some increased salivation which soon gave way to marked dryness and hoarseness. The buccal and pharyngeal mucous membrane showed no changes. The condition lasted only a few days.

2. *The True Roentgen-Ray Reaction*: The author's own cases (13) showed only some skin erythema with but a few whitish patches in the laryngeal mucous membrane. In only one case was there any difficulty in swallowing and this was transient. Marshick, however, had one case with marked edema of the larynx which required tracheotomy. The condition soon improves.

3. *The Late Lesions*: The author calls particular attention to the late changes which follow even when the skin is entirely unharmed. The changes are those of atrophic conditions setting in in the finer musculature, perichondritis, and cartilage necrosis which does not show alarming symptoms within the first four weeks. Five illustrative cases are cited by the author. All five are similar in their history.

One case was that of an irradiation for sycosis occurring in one large field on either side, extending from the eyes to the clavicle. One skin unit dose was delivered to each side. There was no skin burn. At first there was marked dryness of the throat with hoarseness, with transient paralysis of one vocal cord from which patient recovered. After eight months patient complained of sore throat, hoarseness and stridor. Examination showed loss of flesh, reddened and swollen epiglottis, gray patches on the left side, on the left aryteno-epiglottidean fold, and on the left ventricular rim. The right arytenoid cartilage was thickened, with slight exudate. No diptheria bacilli were found. Increasing swelling of the epiglottis required tracheotomy and because of obstruction of the esophagus artificial administration of food was necessary. A few days later a piece of cartilage was coughed up. Roentgen examination of the larynx revealed irregularity of contours. Marked swelling of neck followed which necessitated a gastrostomy. One month later patient died. Section showed the following important findings: (1) Degenerated musculature of the floor of the mouth. (2) Necrotic cavities in the laryngeal carti-

lages. The aryteno-epiglottidean folds were destroyed. The upper border of the epiglotis was slightly discolored and brittle. (3) The pharyngeal vestibule, the ventricles and their rims were changed into a necrotic, greenish-black, ill-smelling mass. Also the vocal cords were discolored and brittle, and could barely be identified. The thyroid cartilage was not affected. Only at its lower edge a pea sized spot of brittle consistency could be found. The arytenoid cartilages were destroyed, while the cricoid cartilages were not affected. (4) Microscopic examination showed a decrease of capillaries, thickening and obliteration of blood vessel walls, generalized increased connective tissue. There was also fatty degeneration of the neck musculature.

The author considers injury to the blood vessels the most important cause of the condition.

In a similar case which was treated with deep roentgen-ray therapy for papilloma of the larynx, there were good therapeutic results for the first two months, when the late injuries began to manifest themselves. Tracheotomy and gastrostomy were necessitated. Death followed and section showed findings similar to those of the case above. It is important to note that the original pathological condition had been cured.

The author arrives at the following conclusions: (1) Under no circumstances, should a carcinoma dose or a 100 to 120 per cent skin unit dose be delivered to the larynx. (2) An operable carcinoma of the larynx should not be treated with x-rays. (3) An irradiated carcinoma of the larynx

should not be subjected to surgery.

The author noted that in most cases the x-ray ulcer was located on one side or the other, showing that one part received more radiation than another. He, therefore, advised the use of paraffin upbuilding for homogeneous radiation. Holfelder uses a specially prepared paraffin collar for this purpose. At first, attempts at a 90 per cent dose should be made. In larynx papilloma only 80 per cent should be used. Should not be repeated unless especially indicated.

A. M. Pfeffer, M. D.

X-Ray and Radium Treatment of Goiter. G. W. Grier, M. D., Atlantic M. J. 26:516, May 19, 1923.

THIS paper was read in the Symposium on Goiter before the Section on Surgery of the Medical Society of the State of Pennsylvania, October 4, 1922.

The radiologist intending to treat goiter must first recognize the type of lesion he is to deal with. The prime indication for radiation treatment of goiter is the presence of hyperthyroidism, consequently the best classification is one based on the presence or absence of hyperthyroidism, as follows:

Hyperthyroids:
- Adolescents
- Hyperthyroids without goiter
- Hyperthyroids on basis of old simple goiter
- Exophthalmic goiter
- Introthoracic goiter

Without Hyperthyroidism:
- Adolescents
- Simple goiter
- Colloid goiter
- Cystic goiter
- Introthoracic goiter
- Malignant thyroids

Having determined the presence of hyperthyroidism by clinical evidence and the metabolism test, we next attempt to classify the hyperthyroid cases. Cases not showing hyperthyroidsm should not be radiated, unless malignant, when they may be so treated in conjunction with surgery.

In adolescent goiter, where hyperthyroidism exists, a small amount of x-ray treatment, with proper hygiene will bring about a speedy return to normal.

In cases of hyperthyroidism without goiter, careful consideration must be given to causes outside of the thyroid which may produce hyperthyroidism. After an exciting cause has been found and removed, should the case not then return to normal, radiation is preferred to surgery.

In exophthalmic goiter, the individual requirements need to be considered. If there is acute thyrotoxicosis, rest in bed and medical treatment for the time being is the proper course. The average case may be treated with radiation, usually with good results. If there are pressure symptoms from the growth, surgery is to be preferred to radiotherapy. Surgery is also preferable for patients who, for economic reasons, are not able to carry out the medical or radiation treatment over a long period of time, or whose home conditions or intelligence make the proper hygienic treatment impractical. Also, if the patients are pessimistic or have preconceived ideas that only surgical treatment is effective, they should be operated at once.

In hyperthyroidism on the basis of a simple goiter, the hyperthyroidism can be controlled by radiation, but since it will have little effect on the tumor, operation is usually preferable.

Introthoracic goiter, with hyperthyroidism, can be controlled, but since the radiation usually has little effect on the growth, operation is better when it can be safely done.

The rationale of the treatment of goiter by radiotherapy depends on the inhibition or abolition of the secretory function of the gland, or even the complete destruction of the secreting cells. Obviously, therefore, the treatment is only indicated when there is an excessive secretion, i. e., a hyperthyroidism. If there is no hyperthyroidism, radiation is contra-indicated. Radiation must be supplemented by a careful regulation of the patient's hygiene, especially as regards rest. They must have eight to ten hours sleep each day, with plenty of fresh air and nourishing food. Stimulating drinks are forbidden and meat is only occasionally allowed.

X-ray is used on office cases for purposes of convenience only, the action of the two agents being regarded as identical. Radium is used on patients confined to bed.

Treatment is not to be continued indefinitely if there is no improvement. The average case requires about six months for regression to the stage where treatment can be discontinued.

W. Warner Watkins, M. D.

Lung Abscess. George J. Heuer, M. D., Minnesota Med. 6:279, May, 1923.

FROM the standpoint of etiology, tonsillectomy is at present the most common cause of lung abscess. In every large and small series of recently reported cases it stands out as the foremost cause of lung abscess and the number of reported cases is rather alarming. After studying the various views expressed in literature, certain facts stand out:

(1) Lung abscess follows tonsillectomy and the operation is responsible for the disease. (2) The vast proportion of lung abscesses follow tonsillectomy done under general anesthesia. In 76 reported cases of one series, 74 had had a general anesthetic. (3) Abscess does follow tonsillectomy done under local anesthesia but the proportion of cases is small. (4) Lung abscess follows tonsillectomy even when, according to the author's statement, the operation is done with every possible precaution.

Aspiration of foreign bodies is the cause of a fairly large number of abscesses though not nearly so great as the preceding cause, probably ten per cent of the reported cases being due to foreign bodies.

Lung abscesses also occur secondary to infectious processes elsewhere, such as liver abscess, appendicitis with peritonitis, mastoiditis, empema,

etc. In the author's series of 62 cases, 7 cases followed acute abdominal conditions, 2 acute mastoiditis, 3 septicemia following acute osteomyelitis, and 15 were associated with empyema.

Lung abscess may follow other surgical operations than tonsillectomy; in the author's series, 14 of 62 lung abscesses followed such operations.

Lung abscess secondary to pneumonia is given in all earlier statistics as the most frequent form, and this was true in the author's series.

Many cases of lung abscess are multiple, though seldom so recognized during life. In diagnosis, although we still rely upon an accurate history, a careful physical examination, on cough and character of sputum, we must admit the enormous value of the x-ray in detecting and localizing the abscess.

Treatment is discussed under the headings of (1) spontaneous recovery; (2) artificial pneumothorax; (3) surgical drainage; (4) thoracoplasty; (5) bronchoscopic irrigation; (6) lobectomy.

"Our experience simply demonstrates that lung abscess as seen in a general service occurs as a complication of many conditions and presents itself in a variety of forms. It may be overshadowed by other conditions, and, as in fourteen of our cases, be discovered in the autopsy room, and present itself in multiple form quite unfavorable from the standpoint of surgical treatment. It may be recognizable but occur in multiple form so as to defeat our surgical efforts, as in six of our cases."

Serious efforts should be made at the present time to prevent lung abscess, by measures which the etiology of the disease would indicate, and to prevent the development of chronic abscess by early active treatment of the acute abscess.

W. WARNER WATKINS, M. D.

The Fluoroscope in Modern Cardiology. Louis F. Bishop, M.D., Sc. D., F.A.C.P., New York State J. Med. 23:205, May 1923.

THERE is nothing that can take the place of fluoroscopy as a short cut in the diagnosis of cardiac disease. It puts one immediately on the track of the disorder but later it must be combined with every other method of examination as a means of determining the nature of the trouble. In the severer types of heart trouble that have led to important changes, the picture often tells the entire story. But its greatest value is in the detection of minor impairments where the stethoscope has entirely failed.

In the examination of a large number of patients to determine which are needful of detailed cardiological study fluoroscopy is a particularly valuable procedure.

Changes in the position and size of the heart can easily be noted and usually direct evidence can be obtained as to the cause of these changes.

W. WARNER WATKINS, M. D.

Rontgen Ray as an Adjuvant in Treatment in Advanced Cases of Carcinoma of the Stomach. Chas. R. Robins, M. D., Virginia M. Monthly, 49:331, April 1923.

WHILE this paper is based on one case only, it is presented because the case was so thoroughly studied. Other cases have been handled by combined surgery and x-ray treatment with very gratifying results in relief of symptoms.

X-ray showed a constant defect in the stomach, and it was thought a radical operation might be done. Exploration showed a hard indurated tumor involving the stomach just proximal to the pylorus; it was freely movable but seemed to involve the lumen of the stomach enough to almost occlude it; metastases to the glands were found, and a posterior-gastroenterostomy was rone for temporary relief. As soon as patient could be moved, x-ray treatment was administered by Dr. Fred M. Hodges. From the first treatment the condition began to improve, and continued to improve so far as the stomach symptoms were concerned, however, the patient died, fifteen months later, of carcinoma of the liver.

W. WARNER WATKINS, M. D.

Congenital Pyloric Stenosis in Adults. Lothar Heidenhain, M. D. and George B. Gruber, M. D., Deutsch. Ztschr. f. Chir. 179:330-387, May 1923.

PATIENTS complain of intense pain in the epigastrium coming on at various intervals after meals. Some are very sick. Often there is some occult blood in the stools. These cases are often diagnosed as ulcer in the pyloroduodenal region. On operation neither ulceration, nor scarring can be found, yet the pyloric opening is markedly narrowed so that only the tip of the little finger can pass into it. The gastro-enterostomy successfully obviates the symptoms. Such cases are usually considered to have had either an open, unrecognizable or a healed ulcer.

In a number of resected portions of the pylorus the authors observed an anomalous narrowing by ring formation due to muscular hypertrophy, the pathological condition being similar to that observed in infants.

The authors are of the opinion that in a large number of cases the complaint of gastric difficulties is due to a stenosis of the pyloric ring produced by a hypertrophic condition of the musculature. Moreover, ulceration of the pyloroduodenal region is often secondary to this hypertrophic stenosis. This condition of hypertrophic stenosis is, furthermore, congenital and may or may not have given symptoms in infancy.

The authors quote many authorities who report an apparent cure in children who had received medical treatment for a hypertrophic pyloric stenosis but in whom a laparatomy, performed later for some other cause, revealed persisting stenosis.

They also maintain that, in absence of any surgical intervention, the pathological condition in infants is eventually compensated by a generalized hypertrophy of the gastric musculature. This hypertrophy is sufficient to permit normal function of the stomach unless, due to some cause, there sets in either a weakening of the gastric musculature or an increased spasm of the pyloric rgion.

In a large number of cases cited by the author there were some in which operation revealed ulcerations, and many in which no trace of ulcer could be discovered. They all presented a narrowed pyloric ring which would not permit the passage of the tip of the little finger. Most of them presented a flabby stomach wall with some dilation. Roentgen-ray findings revealed an atonic stomach, mostly down in the pelvis, with some smaller or larged residue after six hours.

Accompanying microphotographs of sections of the pyloric region, where resected, show normal mucosa, but increased musculature, chiefly on one side. In one section one can see the muscular coat on one side four times as thick as the muscular coat on the other side of the ring.

A number of photographs of stomachs laid open show the thickening of the pyloric musculature in either one side or the other.

A. M. PFEFFER, M. D.

Roentgen-Ray Diagnosis of Diverticulum of the Duodenum, With Special Consideration of Etiology. W. Baensch, M. D., Fortschr. a. d. Geb. d. Roentgenstrahlen. 30: 322-326, 1923.

THE diverticulum is visualized as an opaque spot (at times accompanied by layer formation and gas bubble) near the duodenum, which may often persist for days. It is visualized by compression of the duodenal jejunal flexure. The true duodenal diverticulum, whose walls are

histologically identical in structure with the rest of the intestinal tract, and which is usually congenital, is most frequently found in the descending and inferior portion, rarely in the ascending or upper portion of the duodenum. Its walls may show peristaltic movement. The author describes a case of diverticulum of the superior portion, diagnosed by the roentgen ray examination and confirmed by section.

It should be borne in mind that if the duodenal diverticulum is located in the concave side of the pars inferior, it may be unfilled in the standing position and may not be visualized.

Aside from the true diverticulum are such produced by a herniation of muccus membrane only without covering of the rest of the coats. Such diverticula appear quite frequently and are roentgenologically of small dimensions. They may be found in any portion of the duodenum. Also through dilation of the openings of the ductus choledochus and Wirsung's duct a type of diverticulum may arise. These diverticula are found in the descending portion and show at their blind end a division at the meeting points of the two ducts.

In the differential diagnosis must be considered possible perforations with adhesions, perforation of a gallbladder empyema, niche of the lesser curvature, and pocket formation of duodenal ulcer origin.

A. M. PFEFFER, M. D.

Value and Limitation of the X-Ray in the Diagnosis of Chronic Appendicitis. Lester Levyn, M. D., F.A.C.P., New York M. J. & M. Rec. 117:688, June 6, 1923.

THIS author's conclusions from his observations in chronic appendicitis, are:

Many symptoms are common to numerous abdominal conditions; the x-ray is of value in differential diagnosis of these, and almost always is capable of eliminating certain organs and detecting the offender.

Obscure symptomatology may be due to unsuspected appendiceal disease discovered in the course of an examination of the gastro-intestinal tract.

Tenderness over the McBurney point does not necessarily indicate appendicitis, because the appendix may be remote from this site. Its location can be determined by the fluoroscope.

An appendix that retains barium after the cecum has emptied is not necessarily diseased.

Size and position in the absence of certain signs are of scarcely any significance.

Left sided appendix can be demonstrated by no other method.

The roentgen evidence of involvement of the appendix is as follows: 1. A visualized appendix that is definitely sensitive to fluoroscopic palpation. 2. Inability to visualize the organ because of obliteration of its lumen, together with a cecum tender to pressure. 3. Persistent kinking or constrictions. 4. Concretions. 5. Adhesions. 6. Reflex pylorospasm.

W. WARNER WATKINS, M. D.

Pyelography: Common Diagnostic Errors. Miley B. Wesson, M. D., California State J. Med. 21:193, May 1923.

UROLOGY has become a very attractive specialty, because of the accuracy of diagnosis. In this specialty, pyelography is one of our most important diagnostic procedures but can not be depended upon alone, as it is very easy to misinterpret the pyelograms.

A large proportion of the pyelograms and ureterograms are valueless because of (1) incomplete filling of the pelvis and (2) splinting effect of the catheters in the ureters. In order to avoid pain the catheter should be in or nearly in the pelvis when the injection is made, then it should be withdrawn six inches and the ureter injected. The ideal method is to inject under fluoroscopic vision.

In searching for stones, the first radiographs should be plain films of the genito-urinary tract, which in 90 per cent of the cases, will show the kidney outline, and stones if present. Pyelograms and ureterograms are necessary to localize doubtful shadows.

Ureteral strictures and dilatations are important, but should not be diagnosed, unless they are persistent on a number of films. Peristaltic constriction waves are easily demonstrated under the fluoroscope or with a series of radiographs. Reports of strictures based on single exposures are justly to be regarded with skepticism.

The most confusing pyelograms are those of early hydronephrosis, (through failure to recognize as normal the bizarre shaped pelves). All pelves with a capacity between 3 and 12 c.c. whose secondary calices terminate in delicate cup-like processes are to be regarded as normal. The earliest evidence of hydronephrosis is a flattening and broadening of the delicate minor calices; next, a broadening of the base of the calices, and in increase in size of the true pelvis; finally, all variations up to a rounded sac.

Renal motility causes an intermittent distention of the pelvis with colic, but the obstruction is of such short duration as never to cause dilatation. Horizontal and vertical firms are of value in determining renal motility. There is normally a certain amount of motility and often when the radiograph is taken with the catheter in situ this acts as a splint and the heavy filled pelvis and funnel-like upper end of the ureter may sag down and make a much sharper kink than is really present under usual conditions.

In early renal tuberculosis, pyelograms are of great value, as they show erosions of one or more minor calices, with or without dilatation of the major calyx. In advanced cases, plain pictures showing the characteristic calcium deposits are more important than pyelograms.

In tumors, early diagnosis is of prime importance, and pyelography is therefore essential. The changes to be looked for are (1) Elongation of the pelvis; (2) distention or retraction of one or more calices or the whole pelvis; (3) filling defects of the pelvis from invasion of its lumen; (4) rotation and abnormal position of an otherwise normal pelvis; (5) enlarged kidney shadow and (6) overlapping of vertebra by the ureter; these changes are not pathognomonic, and all the facts elicited from a careful history and complete examination are necessary.

The amateur with a cystoscope is a dangerous person in medicine, the untoward results being due to (1) passage of a cystoscope in a very old debilitated person; (2) ureteral spasms and complete suppression from trauma; (3) use of toxic fluids; (4) overinjection.

A large series of excellent illustrations made in the Departments of Roentgenology of the Stanford University Hospital, University of California Hospital, Letterman General Hospital, U. S. Marine Hospital and U. S. Naval Hospital, all of San Francisco, accompanied the article.

W. WARNER WATKINS, M. D.

The Sensitiveness of the Adrenal Bodies to X-Rays, and Means to Guard Against Injury to These Bodies in Deep X-Ray Therapy. Drs. Holfelder and Peiper, Strahlentherapie, 15: No. 1, January 17, 1923.

THIS investigation was begun at the Frankfort University Clinic upon the occasion of two cases showing temporary symptoms of Addison's disease after irradiation of the upper abdomen.

The authors review the interesting reports in the literature, which, however, are not altogether reliable on account of the lack of exact scientific procedure. Before giving their findings, so as to afford standards of

comparison, they discuss at some length the normal microscopic anatomy of the adrenals in the guinea pig, the animals used for experimentation.

The guinea pigs were bound to boards, with backs toward the tube, and were covered with leaded rubber, except one transverse strip 3 cm. wide in the region of the adrenals. The adrenals were determined to be at a depth of 1.5 to 2 cm. An H. S. H. tube, 42 cm. spark gap, 2 ma., 0.5 mm. zink filter was used. In all but one animal the skin target distance was 30 cm. Various doses were applied to 15 animals. Some of the animals were killed after some time, and some died of extreme weakness. Autopsies and microscopic sections were studied. The authors give a detailed account of the pathological findings, and a number of microphotographs illustrating the changes which occurred.

The following conclusions are arrived at by the authors: The pathological changes in the radiated adrenals do not run parallel with the quantity of radiation. The clinical condition was not in agreement with the histological changes One animal which received an 180 per cent effectual dose and ran the worst clinical course, gave absolutely normal histological findings. Another animal which received a 90 per cent effectual dose died on the twenty-first day, and showed an extremely lipoid poor adrenal body, which finding is often spoken of as adrenal scurvy. There were three cases receiving 60 per cent, 75 per cent and 120 per cent respectively, which showed equally marked destructive changes. There were, on the other hand, cases which received 60 per cent and 100 per cent with but slight changes. The conclusion is, therefore, that the sensitiveness of the adrenals to irradiation is markedly variable. This explains the variety of reports in some of which small doses exerted marked influence, and in others large doses had no effect.

Since in some individuals the adrenals may have a particular sensitiveness to irradiation the adrenal bodies should be excluded from the field of irradiation. Slight changes in the direction of the beam will be sufficient to avoid the adrenals.

A. M. Pfeffer, M. D.

Adrenalin Content in the Adrenals After Irradiation by X-Rays. Drs. David and Hirsch. Klin. Wchnschr. 2:790, April 1923.

THERE have been various reports concerning the action of roentgen rays on the adrenal bodies. One group of observers found definite changes in the blood pressure, another group found changes in the sugar metabolism following radiation. Still another group could find no definite results.

The authors studied the adrenalin contents in guinea pigs and rabbits, and dogs, 40 in all. In each one, one adrenal body was isolated and exposed to the rays, which were of a definite quantity, while the other adrenal was thoroughly protected from the rays. The application of rays varied from one skin dose to one-fourth skin dose. Conclusions by the authors: (1) The adrenal system is influenced by radiation with x-rays. (2) A distinct lessening of function is obtained by a radiation of one skin dose. (3) An increased function is obtained by radiation with one-fourth skin dose.

A. M. Pfeffer, M. D.

Radium in Carcinoma of the Breast: A Necessary Preoperative Routine. George Stuart Willis, M. D., New York M. J. & M. Rec. 117:454, April, 1923.

IN more than 60 per cent of the cases the axillary nodes are palpable at the time the patient comes for operation, and according to Ewing only one cure in twenty-five may be expected from operation in this type of case. Surgical statistics show that about 35 per cent of patients operated for carcinoma of the breast are alive at the end of three years and twenty-five per cent at the end of five years. Handley states that recurrences are mainly of the intercostal and supraclavicular types. He states further that radium should never be omitted in the treatment of supraclavicular metastases. Radium postoperatively and in recurrences has given results which justify its use. The most successful results will be obtained when radium as a routine measure is used postoperatively.

In the early technique of radium application, this was entirely superficial, the patient frequently receiving as much as 35,000 mg. hours in one week; many of these patients had a radium toxemia. The introduction of radium needles revolutionized the technique. The author now uses a special transfixion needle 15 cm. long containing 33.33 mg. of radium if necessary, these are reinforced with smaller needles. After thorough radiation of all parts of the tumor by these needles, a violent reaction occurs, which subsides in seven or eight weeks, and surgical treatment is not to be advised until this stage is reached. Within six weeks of the operation, a complete raying of the scar and surrounding lymphatic area is given.

The author gives the history of seven cases in detail.

W. Warner Watkins, M. D.

Special Features of Radium Therapy in Gynecology. Arthur H. Curtis, M.D., Wisconsin M. J. 21:498, April, 1923.

IN hemorrhage of the menopause, the author employs 10 or 12 hrs. with 100 mg. m. thinly screened, held by a Michel clip at the external os. Two or three applicators in tandem throughout the uterine cavity are better than a single applicator.

The so-called myopathic hemorrhage of younger women is best managed by smaller doses (e. g., 100 mg. for four or five hours); this may be repeated after four or five months, if necessary.

In fibroids in young women, radium is ill-advised unless operation is contra-indicated; it is likewise contra-indicated in abdominal pain, in presence of active pelvic infection, in rapidly growing tumors, and where the diagnosis is uncertain.

In only one type of pelvic infection is radium indicated and that is chronic leukorrhea. Smaller doses are preferred.

In cancer, radium is used without operation in practically all cases except that of the fundus. Two treatments are the rule, as it has been found that additional radiation does harm rather than good. Applications are made in the canal and by burying needles around the periphery of the growth. The first treatment is 3500 mc., the equivalent of 100 mg. for 35 hours. The second treatment is not given for two months, when about two-thirds of the first dose is given.

After the second treatment, there may be a hard induration resembling cancer, but this should not be treated, it is the result of the radium and further applications would be dangerous.

W. Warner Watkins, M. D.

Inoperable Carcinoma of the Cervix: A Report of Three Cases in Which Radiatherapy Arrested the Disease. S. D. Neeley, M. D., J. Oklahoma M. A. 16:113, May 1923.

SECONDARY conditions such as tuberculosis, diabetes, nephritis, etc., render operation almost certainly fatal. Crossen says the operable cases are those in which the malignant disease is still confined to the tissues that admit of complete removal, and where the patient is in condition to stand the radical operation. Cases inoperable because of the patient's condition or disease have their only hope of cure

or comfortable lease of life in radiotherapy.

Case I: This was a carcinoma involving the left parametrium, with a mass the size of an orange in the broad ligament, the cervix had a cauliflower growth which obliterated the canal, and extended down on the vaginal surface. This case was given 2400 mg. hrs. of radium inside and outside the cervix, and the skin dose of hard, filtered x-rays was given twice. Lesion has entirely disappeared. Patient is now doing her household work and feeling well.

Case II: This was a large fungating growth obliterating the cervix, with a mass as large as a grapefruit in the left pelvis. Patient was given 2500 mg. hrs. intracervically and against the cervix and a month later 2,000 mg. hrs. Growth on cervix cleared out in two months. She was given x-ray to tolerance and all palpable signs of the tumor have disappeared.

Case III. This was a growth the size of a hen's egg and formed a hard, resistant, indurated mass in the left pelvis. It was given 2500 mg. hrs. and one month later 2000 mg. hrs. Cervix became normal within two months. Treatment was supplemented by hard x-rays.

W. WARNER WATKINS, M. D.

Radium as an Adjunct to Surgery in Uterine Conditions. W. P. Fite, M. D., J. Oklahoma M. A., 16: 182, June 1923.

IN borderline and inoperable cases of uterine carcinoma, surgery is manifestly contra-indicated and radium the method to be employed. Wherever the involvement has extended beyond the cervix, the cases have, in the past two years, been treated exclusively by radium and x-ray, and the results certainly justify this course. With the involvement limited to the cervix, operation is still preferred; likewise, operation is preferred in cancer of the body of the uterus.

In fibroids in young women, radium is not used unless operation is contraindicated or refused and the patient thoroughly understands the probable effect on the menstrual function. It should not be used after recent pelvic infections, in fibroids larger than a four months' pregnancy, in pedunculated growths, in cystic or myxomatous fibroids. Tumors diagnosed as fibroids but which continue to enlarge after treatment should be promptly operated.

W. WARNER WATKINS, M. D.

Fractures of the Scapula. Emile Bloch, M. D., New Orleans M. & S. J. 75:704, May 1923.

FRACTURES of the scapula are comparatively rare, among 2,358 cases at Hotel Dieu there were four. At the Charity Hospital from January 1906 to November 1922 there were recorded 8097 fractures, of which 28, or 2.89 per cent, were fractured scalpulae.

The majority of scapular fractures result from direct violence, with indirect violence and muscular action as rarer causes. All the series reported here were from direct violence.

In ten of these cases, the location of the fracture in the bone was not recorded. In six the fracture was in the body. In six the acromion process was fractured. In one the wing of the scapula was fractured. In one the scapular neck was fractured. The fracture extended into the glenoid in two cases. The coracoid process was fractured in two cases.

The author calls attention to the fact that the acromion process is completely ossified in the nineteenth year, contrary to the usual idea. Careful attention must be given to epiphyseal lines otherwise mistakes will occur in interpreting radiographs.

W. WARNER WATKINS, M. D.

Indications for Radium Treatment; Summary of Results. Lawrence A. Pomeroy, M.D., F.A.C.S., Ohio State M. J., 19:324, May, 1923.

THIS report is based on a series of 250 consecutive cases applying for radium treatment. The two important actions of radium on cancer are: (1) a direct destructive action on the cell nuclei; (2) an indirect action leading to the formation of fibrous tissue. There are two different methods of treating cancer with radium. One is to attempt the total destruction of all the cancer cells in one lethal dose; the other is to deliver the dose in fractional amounts attempting to destroy the cells when their nuclei are in process of division. As a rule the first method is used.

In 11 cases of lip cancer, 4 were not sufficiently treated, and 4 improved for a period of from one to eighteen months; 3 cases are apparently arrested after periods of from two months to two years.

Of 11 cancers of the tongue, 3 were not sufficiently treated, 3 were unimproved, 2 improved and 3 apparently were arrested.

Of 27 cases of malignant disease of the mouth, nose, pharynx and tonsil, 3 were not sufficiently treated, 7 were unimproved, 9 were improved and 8 remain apparently arrested.

Of 44 cases of cervical cancer, 2 were not sufficiently treated, 2 were not improved, 30 were improved, and 10 remain apparently arrested.

In 20 malignancies of the rectum and anus, 4 were not sufficiently treated, 2 were unimproved, 12 improved and 2 were apparently arrested. Preliminary colostomy should always be done before rectal malignancy is treated with radium.

W. WARNER WATKINS, M. D.

To Writers of Medical Papers. Editorial, Boston M. & S. J. 188: 1046, June 28, 1923.

"IT is a question whether writers of medical papers realize the responsibility that rests upon them when they quote the work of others * * *

"Recently attention has been drawn to the gross carelessness that exists among American writers in regard to exact quotations, proper spelling of authors' names and proper references in their bibliography.

"Probably in no single country does such a state exist to the same degree as it does here. A very few of the American medical publications verify such references and these are to be thanked for the hours of labor and careful search they have spared other investigators.

"In a recent extensive bulletin no less than eight references out of twenty-eight were wrong, two authors' names were spelled incorrectly and two articles were quoted that had no reference whatsoever to the text of the author's paper.

"* * * If criticism is to be avoided as to the author's faith and honesty, or unless writers wish to shake the faith of the reader in the reliability of the information presented, greater care must be shown in respect to the work of others.

"Let this matter be remedied now before we earn a name for which we shall have only ourselves to thank. Let the writer realize his responsibility and be fair, courteous and above all accurate."

Roentgenologic Diagnosis of Carcinoma of the Tail of the Pancreas. Thomas Scholz, M. D. and Felix Pfeiffer, M. D. J. A. M. A. 81: 275-277, July 28, 1923.

TWO cases are reported and the authors' conclusions from the study of these two are as follows: "In carcinoma of the tail of the pancreas, roentgen ray examination may furnish important diagnostic information. Roentgenologic examination reveals a permanent, irregular outline defect at the middle portion of the greater curvature of the stomach. Such an outline defect, although usually characteristic of, and interpreted as, neoplasm of the gastric wall, may some-

times be correctly recognized as being due to carcinoma of the tail of the pancreas, if the interpretation of the roentgen ray findings is guided by a full and proper consideration of the clinical aspect of the case. The main differential diagnostic feature in such instances is an obvious disharmony between the roentgenologic and the clinical manifestations, the latter showing a striking lack of direct gastric symptoms.

"Urgent call is made for a closer cooperation between clinician and roentgenologist, and an interpretation of roentgen ray findings along clinical lines—in short, for clinical roentgenology, because we sincerely believe that in clincal roentgenology lies the further development of radiodiagnostic possibilities."

The Roentgen Picture of the Bladder After Operation. Friedrich Kraft, M. D., Acta Radiologica 2:182-185, No. 6, May, 1923.

TYPICAL changes are encountered in the roentgen picture of the bladder after operation (with the exception of endovesicular methods).

A changed formation is often seen in the "fore-bladder" (better called the "after-bladder") after prostatectomy owing to the insufficiency of the internal sphincter muscle. An asymmetrical bladder shape often follows upon diverticulum operations. The changes consequent upon a suprapubic cystotomy are very difficult of roentgenologic demonstration. Incrustation of the sutures may lead one to a mistaken diagnosis of stones.

Complete Examination in Diseases of the Upper Right Quadrant. J. F. McCullough, M. D., and F. L. Schumacher, M. D. Pennsylvania J. Roentgenol. 4:1-8, July, 1923.

IN an examination of the upper right quadrant retroperitoneal pathology must first be eliminated by examination of the urinary tract, then a search for direct signs of cholecystitis must be made before examination by the opaque meal method.

Detailed directions are given for the roentgen examination for pyloric stenosis, pyloric spasm, gastric ulcer, gastric cancer, duodenal ulcer, and gall-bladder pathology.

The X-Ray Diagnosis of the Pathological Gall-Bladder. Abstract of an abstract of the Fourth Mackenzie Davidson Memorial Lecture, delivered by Dr. A. W. George, May 17, 1923. J. Roentgen Soc. 19:148-149, July 1923.

IN a large number of cases the shape, size and position of indefinite shadows on the x-ray plate are suggestive of gall stones. Often in such cases stones are not present but the shadow is due to a thickened gall bladder wall, inspissated bile or very thick, dark bile. This indirect evidence is very important.

A normal gall-bladder is not usually visible by x-rays nor does it cause pressure upon the gastro-intestinal tract rendered opaque by barium. A pressure deformity is nearly always due to a pathological gall-bladder. Such a deformity throws a half shadow, due to a concave or rounded surface pressing against a similar surface, the first part of the duodenum. If the edge of the liver presses against the duodenum the half-shadow is lacking—a fact which is of great importance in diagnosis. This pressure from a pathological gall-bladder is due to a tension within the gall-bladder greater than that within the barium filled duodenum. The lateral view is the position of choice.

The second part of the duodenum in normal individuals extends downwards parallel to the vertebrae and passes up behind the stomach as the third portion. In gall-bladder disease this second part is often directed out toward the liver and often outlines the size of the gall-bladder. The position is usually due to gall-bladder adhesions. Burnham of San Francisco is given credit for the observation that a duodenum passing backward toward the vertebrae and forming an angle passing down again to normal position is significant of gall-bladder pathology. Postoperative cases are most difficult to diagnose.

Pressure of the gall-bladder upon the antrum of the stomach frequently occurs as a pressure deformity in the first portion of the duodenum and in many cases the pressure involves both viscera at once. The half-shadow effect must be noted here.

The transposition of the jejunum from its normal position on the left side to the upper right quadrant frequently helps in diagnosis, however, this is at times due to peritonitis (especially if of a tuberculous nature) in early life.

In every case in the speaker's experience in which a series of gastro-intestinal films has shown the ampulla of Vater to be filled with barium, disease of either the gall-bladder or the pancreas has been found.

Often the only sign of a pathological gall-bladder is the "pseudo-hypatic flexure", a change in the position of the proximal end of the transverse colon somewhat like a secondary hepatic flexure.

With proper examination a diseased gall-bladder can in almost every instance be demonstrated on the plate. Even cholestrin stones, if present in large numbers, can be shown if only from the increased density and change in the shape of the gall-bladder. Therefore the negative findings have some value.

Carcinoma of the Small Bowel. Milton M. Portis, M. D., and Sidney A. Portis, M. D., Am. J. Roentgenol. 10:419-423, June, 1923.

CARCINOMA of the small bowel is exceedingly rare but is not difficult of diagnosis.

There are three distinct types found: (1)part of a local or general intestinal polyposis, more frequently found in the colon; (2) single or multiple benign embryonal carcinoid tumors found as opaque nodules the size of a pea or bean in the mucosa or submucosa of the ileum or jejenum; (3) localized adenocarcinoma which reaches a sufficient size when ulceration is delayed to obstruct the lumen, usually ulceration and stricture result.

Previous to obstruction symptoms may not be noticeable to the patient. Occult blood in the stool is one of the earliest symptoms. Asthenia and vague abdominal discomfort may be early symptoms. Pain is a later symptom and increases with obstruction. Constipation may be present or diarrhea or both alternately. Belching, nausea, anorexia, thirst and vomiting occur. With developing stenosis there will be tympanites, visible peristalsis and the tumor may be palpated.

The stomach may be ruled out by laboratory and x-ray examinations. A routine examination of all stools for occult blood will aid in early diagnosis when a cure may result, but if the case has reached the point where an operation for acute obstruction is necessary cure is then impossible.

Roentgen Gastro-Intestinal Studies of Patients with Deforming Arthritis. R. G. Taylor, M. D., Am. J. Roentgenol. 10:424-427, June, 1923.

THESE studies are based upon the theory of a gastro-intestinal origin of deforming arthritis.

Observations were made at 6, 9, 11, and 24 hours after ingestion of the meal. The majority of patients were found to have a certain type of colon characterized typically by its abnormal length and abnormal mobility. Second, practically all cases that have become chronic show so-called surgical lesions in the right colon, or in the ileum, or in both. Third, these lesions consist of adventitious bands similar to Jackson's membrane involving the colon, usually above the ileo-

cecal valve, and involving occasionally the ileum, producing the so-called Lane kink and other less typical fixations, or chronic appendicitis, or the results of an acute inflammatory process in the appendix with adhesions and fixation of the cecum and appendix to surrounding structures, notably the ileum and right colon itself (the appendix is frequently retrocecal), or if postoperative adhesions following removal of the appendix." These adhesions and bands result in a crippling of the intestines which will be evidenced as deformities in the barium shadow. Local stasis favors infection and perversion of the normal flora.

The demonstration of the lesions which are probably responsible for crippling and stasis is of chief interest to the radiologist. Some cases which show a crippled condition but no actual stasis offer a chance for purely medical treatment, the others are surgical. In the latter case the roentgenologist can assist the surgeon by ascertaining the type, location and kind of lesion to be expected. Nonsurgical cases have shown marked improvement and many of the surgical cases have shown complete arrest of the disease.

Some X-Ray Findings in the Lower Spine and Pelvis. S. A. Munford, M. D., and C. Harvey Jewett, M. D., Clifton Med. Bull. 9:58, No. 2, 1923.

THE authors emphasize the necessity of an x-ray examination of the lower spine and pelvis in patients complaining of pain in the lower back or leg. They give briefly the findings in sixteen cases. Three of these were metastases to the spine from primary carcinoma of the prostate, two more probably primary in this organ, while another had changes in the spine suggestive of primary prostatic carcinoma but was probably primary in the biliary system. Six cases were secondary to carcinoma of the breast. There was one case of an old fracture of the spine following injury seven years before, one case of ostitis deformans and one case of hypernephroma.

Their experience leads them to believe that structural changes in bones are rather frequent in people past middle life who complain of sciatica or pain in the spine, and that x-ray will often reveal changes even if a primary carcinoma is not evident.

—E. A. BAUMGARTEN, M. D.

The Lumbar Transverse Process. Morris I. Bierman, M. D., Am. J. Roentgenol. 10:456-458, June, 1923.

THE development of the lumbar vertebrae is traced through the embryonic to the adult stage.

The author's observations are as follows: "(1) The transverse processes of the lumbar vertebrae, especially the first lumbar, very frequently show anomalous development. (2) The unilateral lumbar rib is easily differentiated from fracture, unelss the rudimentary rib is very short. Then differentiation must be made by the appearance of the bone, the situation of the lesion, and the lack of injury to neighboring parts. (3) Unilateral or bilateral failure of the secondary epiphysis to unite with the transverse process, while probably the least frequent of the two conditions, will at times, also be difficult to differentiate if found after injury."

Roentgenograms of the Fetal Skeleton as a Positive Sign of Pregnancy. Irving F. Stein, M. D., and Robert A. Arens, M. D., J. A. M. A. 81:4-8, July 7, 1923.

UNTIL about a year ago the authors agreed with most other roentgenologists that fetal bones were hard to distinguish radiographically at any time before birth. However, during the last year, as a result of a systematic investigation of 400 cases they have changed their opinion. They have found it possible to demonstrate the whole fetus clearly, in some cases the hands and feet have been clearly shown, at six months but with painstaking technique they have been unable to demonstrate the fetus with regularity before five months and in only three cases out of 400 have they been able to demonstrate the fetus before quickening.

The interpretation of size and age from the shadow is very difficult. Fetal shadows may be very deceptive as to size, e. g., the appearance of a normal head may in the film suggest hydrocephalus, therefore caution in interpretation must be exercised.

Differential diagnosis between twins, monstrosity and hydramnios with a normal fetus can usually be made and almost invariably differential diagnosis can be made between pregnancy and fibroids, ovarian cyst, obesity, ascites, pseudocyesis and menopause. From six months to term the authors secure satisfactory results.

Differences in the Time of Development of Centers of Ossification in the Male and Female Skeleton. J. W. Pryor, M. D., Department Anatomy and Physiology, University of Kentucky Anatomical Record 25:267-275, June, 1923.

THE author says: "In the ossification of the human skeleton the female is in advance of the male from the earliest development of centers of ossification in the embryo and throughout intra-uterine life, progressing from days to weeks and months. After birth the differences are progressive up to the union of epiphyses with the shaft of the long bones, which takes place with the female from three to four years in advance of the male."

These conclusions were based upon a study of the roentgenograms of 140 fetuses (10½ weeks to 38 weeks, 71 male and 69 female) and 100 new born babies (few hours to ten days old, 48 male, 52 female).

Early centers could not be compared as but few fetuses were under twelve weeks, old. Principal points compared were: centers of ossification of the calcaneus, the talus, the cuboid in the tarsus, the epiphyses of the distal extremity of the femur, the central extremity of the tibia and centers of ossification of the capitatum and hamatum of the carpus.

The author believes that it may become possible to differentiate sex and make comparisons of the time appearance of centers of ossification several weeks before the external genetalia are characteristic.

Spondylitis Typhosa. S. N. Bakke, M. D., Acta Radiologica 2:176-181, No. 6, May, 1923.

THIS is a case report which was presented before the Norwegian Society for Medical Radiology. The Clinical picture corresponded to the cardinal symptoms as described by Quincke, namely, very intense diffuse local pains, an acute course, rapid abating of spinal pains, and noticeable swelling of the soft parts of the vertebral column.

The roentgenogram differs from that seen in spondylitis tuberculosa for there is no marked atrophy of lime and no destruction of the vertebral body. "Parallel with the pathological process present in the body of the vertebra there is a proliferating process going on, with a bridge-like connection between the second and third vertebra. The articular space between these two vertebrae is reduced. After fully three months a more transparent portion of the vertebrae was seen on the roentgenograms in profile, a sequestrum(?) being discernible in that point." There was no reaction to tuberculin injections.

A Lecture Delivered at the City of Dublin Skin and Cancer Hospital, on Deep X-Ray Therapy. Dr. Pilger, Erlangen Clinic. Arch. Radiol. & Electroth. 27:364-373, May, 1923.

IN Erlangen, whenever possible, concentrated tubes are used in preference to large cones of irradiation. The U. S. D. dose is defined as the erythema dose that produces a slight reddening within eight days after treatment and "a tender but well visible brown" four weeks after treatment. "This dose, as fixed by a certain number of minutes exposure with a certain apparatus running under certain conditions and a certain tube, was standardized as 100."

In treating uterine cancer six to seven fields are usually used, giving 18 per cent U. S. D. to each field. In thin patients five fields are usually enough. About one-half hour each is given and after six to seven weeks each parametrium is radiated. At the Frankfort clinic the first treatment is by the concentration method and the second by the distant field method.

Cancer of the breast is radiated from two fields, one in front and one behind, and in addition the supraclavicular and axillary glands are radiated. The distance and field size depend upon the location and size of the tumor. The dose is calculated at the lowest limit and therefore two radiations are usually given.

For good results in deep therapy it is absolutely necessary that the cancer tissue be replaced by healthy connective tissue which will give the cancer its final death blow. Therefore there must be adequate preparation of the patient so that the body force may be preserved. The biological effect of the rays, it is stated, is due to the scattered rays, therefore the formation of secondary rays in the body should be reduced as much as possible. Bowels and bladder should be empty, if barium is present it must be eliminated and there should be no metalic medicament present in the body. The compressing applicator is recommended in crossfire treatment because the anemia of the skin thus produced renders it much less susceptible to the rays, also the loose movable tissue of the bowels can be pushed aside.

Blood counts are taken before and after treatment. Providing the patient's general condition is good to start with, the count returns to normal in from three to four weeks. An *ungent leniens molle* is applied to the skin twice a day for several weeks. Rectal injections of pure olive oil are used in gynecological radiations. All patients treated at Erlangen are given printed instructions as to the avoidance of irritation. A subcutaneous injection of physiological NaCl solution is given after radiation and the patient is kept in bed for a period of several days to several weeks. A good light diet, preferably vegetables, is recommended. Intravenous injection of sterilized albuminous preparations is beneficial after treatment as is also treatment by iron and arsenic.

It is too early to say whether the new deep therapy will in time entirely replace surgery in cancer cases although the present results are "at least as good as surgery." The author says it must be remembered that "in compiling statistics the surgeon takes only operative cases into consideration and excludes inoperable ones whilst x-ray therapy statistics include a large number of inoperable cases in which x-ray treatment is the only possible one."

Sarcoma, lymphosarcoma, Hodgkin's disease, myoma and "climateric diseases", tuberculous glands, tuberculosis of the peritoneum and of the joints, and many skin diseases are named as lesions in the treatment of which the x-ray has proved itself of undoubted value.

The Present Status of Radiotherapy. H. W. Van Allen, M. D., Boston M. & S. J. 189:5-8, July 5, 1923.

ROENTGEN history is divided by this author into three periods the optimistic, the pessimistic, the realistic. The latter in general characterizes the present time though illustrations of the pessimistic attitude are still to be found. Dr. Borden's article in the Boston M. & S. J. (abstracted in the J. Radiol. June, p. 212) is illustrative of the pessimistic attitude. Dr. Van Allen charges that the results in these cases were due to the fact that the Witherbee technique was not strictly adhered to as only half the number of required treatments were given, hence results could not be satisfactory.

Out of the writer's experience of twenty-five years in the practice of roentgen therapy and many years in the practice of radium therapy he relates success in the treatment of the following lesions: Epithelioma (radium), minor superficial lesions such as keratoses, warts (many so-called corns are warts), keloid, pustular acne (in this the real cause must be sought out and removed or cure will not be permanent), excessive local perspiration, some forms of eczema, psoriasis (believes results with this due to systemic result), and last among these, ringworm.

He reports prompt and satisfactory results in x-ray treatment of the thymus. Leonard of Boston is cited as being successful in x-ray treatment of whooping cough. Hyperthyroidism the writer believes should usually be treated by the x-ray rather than by surgery. In tonsillar cases he prefers radium to x-ray. Angioma, either deep or artificial has yielded good results in his practice. Success in deep therapy is recounted.

The Treatment of Active Infantile Tetany with Radiations from the Mercury Vapor Quartz Lamp. Horton Casparis, M. D., and Benj. Kramer, M. D. Bull. Johns Hopkins Hosp. 34:219-220, July, 1923.

FIVE cases of infantile tetany were treated. Clinical manifestations were unmistakable and three of the patients had convulsions before treatment. Symptoms disappeared after raying, and healing of the rachitic process occurred in every case. The calcium concentration of the serum was raised and also the inorganic phosphorus concentration of the serum was raised to the normal level or above.

A diet of milk and farina was adhered to throughout the treatment. The technique of treatments was as follows: Distance 18 inches, intensity 9 amperes. Time—*1st day*, 5 min. front, 5 min. back; *2nd day*, 10 min. front, 10 min. back; *3rd day*, 15 min. front; *4th day*, 15 min. back; *5th day*, 20 min. front; *6th day*, 20 min. back, and so on, alternating front back but at no time exceeding 20 minutes exposure. Clinical manifestations of tetany ceased in from three to seven days.

Some Details of Technique of Actinotherapy in Dermatology. Carroll S. Thomson, M. D., Am. J. Electroth. & Radiol. 41:215-217, July 1923.

IN his practice the author regulates treatment by the first, second, third or fourth degree erythema. First degree erythema gives scarcely a visible effect and is discernible only in a strong light. Second degree gives an effect similar to mild sunburn, third degree resembles a severer sunburn and produces exfoliation of the epidermis. Fourth degree erythema is a blistering erythema.

Each lamp is a rule to itself and every operator should first standardize his lamp on his own skin and, remembering that blondes respond more quickly than do brunettes, govern his technique accordingly.

In difficult dermatological conditions radiant light and heat are used in connection with actinic rays.

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Carcinoma of Lingual Thyroid With Metastases in the Lungs*

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Definition

BY THE TERM "lingual thyroid" is meant an aberrent thyroid located in the root of the tongue. The most frequent location is in the posterior aspect above the hyoid bone. This is the location of the tumor in the case under discussion.

Historical

The first to call attention to thyroid tumor in the tongue was Verneuil, who made the following report in 1853. He says, "while dissecting the insertions of the muscles of the tongue on the hyoid bone, a small glandular mass was exposed which was quite strongly adherent to the middle part of the glossus muscles. This mass was red, soft and sessile, the size of a large pea, with a smooth, shining surface and composed of a homogeneous tissue which upon microscopic examination proved to be that of the thyroid gland."[1] This report was made by an anatomist. Since then, much has been written on this subject by such investigators as Zuckerkandl, Kaydi, Gruber and Madelung.

The first case reported in American medical literature is that of Bernays[2] in 1888. In 1904, Storrs[3] found 29 cases previously reported and added three more. In 1920, Lenormant[4] reported 43 cases, thus adding 11 to those already in the literature. In 1922 J. N. J. Hartley[5] reported one additional case, bringing the total number of cases reported in medical literature up to 44. Of these cases, all were proved by microscopical examination to be normal thyroid tissue. The case which I am adding is the first lingual thyroid, so far as I have been able to determine, which has shown malignant change. Of the 44 cases previously reported, three were males and 41 were females. My patient was a male. Through the courtesy of Dr. Louis McArthur, who operated upon this patient, I am privileged to show a microscopical section of the primary tumor in the root of the tongue (Fig. 1).

Embryology

It will be recalled that during the third week of embryonic life the tongue begins to form. It is formed in two parts, the buccal portion makes up that part of the tongue seen on casual observation through the open mouth in the adult. Embryologically, it is situated in front of the foramen cecum and the V shaped groove. It is covered by papillae, is concerned in mastication and is apt to develop cancer. The phalangeal portion bounds the buccal wall of the pharynx, is covered by glandular and lymphoid tissue and is concerned in swallowing[6]. The buccal part arises as an elevation (known as the tuberculum impar) from the middle portion of the first arch and first interbranchial space. The pharyngeal portion is formed by the second and third arches.

At the same time that the formation of the two parts of the tongue is taking place, a mass of hypoblastic tissue appears in the middle of the furrow between them. This mass forms a solid outgrowth which descends ventrally and caudad to the level of the normal thyroid in the neck. During the second month this mass bifurcates, forms acini and is recognized as the isthmus and major portion of the lateral lobes of the thyroid gland. The path made by the migration of the thyroid is known as the thyroglossal duct, the buccal opening being known as the foramen cecum. Normally, the thyroglossal duct is obliterated at the time the two portions of the tongue are fused. Occasionally, however, some remnants of thyroid tissue are left along the path of descent. When this happens we have a lingual thyroid.

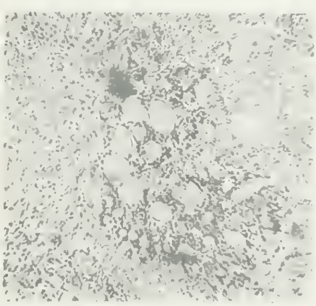


Fig. 1—Microphotograph of section made from tissue removed from the root of the tongue. Notice the presence of colloid material.

Lingual thyroids are divided into two types, depending on the location of the tumor with respect to the hyoid bone. The more frequent variety is that above the hyoid bone. It is this type with which we have to deal in this discussion.

Etiology

Primarily, lingual thyroid is a defect in embryological development. It is interesting to note, however, that it occurs much more frequently in women than in men. Of the 45 cases reported to date, 41 are females and 4 males. The reason for this is not understood any more than we understand why goiters of all kinds are much more frequent in women.

Since lingual thyroid is due to a defect in embryological development, it is found at all ages, from birth to advanced years. In the case reported by Hickman[7] we find a tumor of sufficient size to produce suffocation in a newborn child, while in the autopsy reported by Staelin[8] the subject was a woman of 77 years. My patient was a man of 54 years.

Although present from the first month of intraterine life, lingual thyroids seldom produce symptoms until the time the sex life becomes active. This means that they are usually recognized in women between the ages of 15 and 40. This fact leads one to think that the thyroid tissue found in the tongue undergoes hypertrophy as the ovarian function becomes active. This has been proved in cases where myxedema followed the surgical removal of lingual thyroid, no normal thyroid being present, as in the cases of Seldowitsch,

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 7, 1922.

Kraska and Hartley. On the other hand, Benjamins reports a case of myxedema in a man following surgical removal of a lingual thyroid.

Pathology

The lingual thyroid is usually located above the hyoid bone in the posterior portion of the tongue at the site of the V shaped groove where fusion of the buccal and pharyngeal portions has occurred. It may be centrally located surrounding the foramen cecum as in Bernay's case, but more frequently it is slightly to one side. The tumor is usually ovoid in shape and varies in size from one-half centimeter to five centimeters in diameter. The mass usually produces a prominence on the dorsum of the tongue and when large, projects downward showing under the mandible and above the hyoid bone. When of this size, the root of the tongue will feel thick and boggy to palpation. In lingual thyroids of normal histology, the mucosa of the tongue remains unbroken, but has a bluish color, due to the engorged veins noted at laryngoscopic examination. Occasionally, profuse hemorrhage occurs, due to rupture of one of the vessels involved in the lingual thyroid. Rarely, malignant degeneration may occur.

Symptoms

The leading symptom is that of a feeling of pressure in the throat, causing the patient difficulty in swallowing or in breathing. There is usually a desire to "clear the throat" frequently. This symptom is usually present several years before the cause is recognized.

In some cases the patient may have a severe hemorrhage from the throat due to rupture of one or more of the enlarged vessels in the growth.

Palpation of the tongue with the gloved finger, well back in the pharynx, will reveal the induration and elevation characteristic of lingual thyroid. In addition to this, the laryngoscopic examination will show the engorged vessels and the bluish discoloration characteristic of the thyroid gland.

The presence of all these local symptoms with the complete absence of constitutional symptoms should make one suspicious of the presence of a lingual thyroid.

There are other tumors which may occur in the root of the tongue. Sarcoma, lipoma, angioma, fibroma, syphilitic gumma, lingual tonsil and cyst, make up the list.

Treatment

Medical treatment, such as the administration of sodium iodide and other internal medication, seems to have little or no beneficial effect. X-ray or radium therapy has not been tried on the normal lingual thyroid. In my case, where complete surgical removal was impossible and malignant change had taken place, x-ray and radium were used with great benefit. Metastases had already occurred so that complete cure was made impossible even by radiation. Some have used the galvano-cautery, but with failure because of inability to remove all the thyroid tissue. Clean surgical excision, then, is the best method. Two routes are possible in

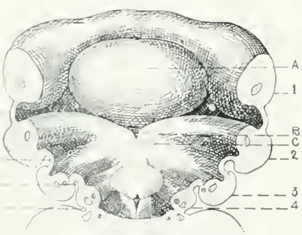


FIG 2

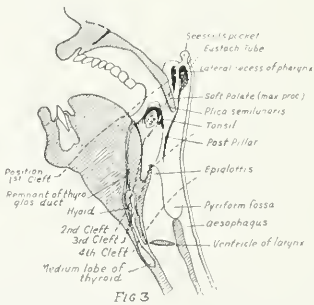


FIG 3

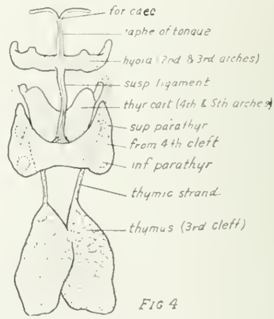


FIG 4

Fig. 2—Vertical section through the pharynx of a human embryo of ten millimeters. After His. 1, 2, 3, 4 Branchial arches. I, II, III, IV, Branchial clefts.
A Tuberculum impar forming front portion of tongue.
B Foramen cecum.
C Archage of thyroid gland.

Fig. 3—After Keith. Showing the position of the visceral clefts in the adult.

Fig. 4—After Keith. Diagram of the thyroid and thymus. The three parts of the thyroid body are indicated by stippled lines.


FIG 5


FIG 6

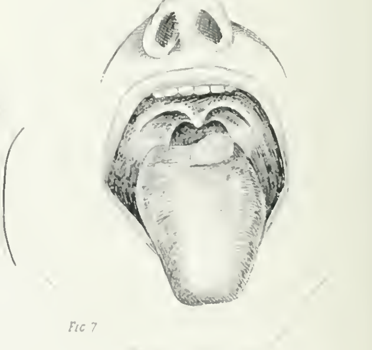


FIG 7

Fig. 5—Drawing showing typical location of lingual thyroid. Fig. 6—Drawing showing location of tumor in the case now reported.

Fig. 7—Drawing showing appearance of tumor on dorsum of tongue in case now reported.

surgical removal, the intraoral and the extraoral. The intraoral is feasible where the mouth is large, the tongue long and slender and the tumor small and situated close to the dorsum of the tongue. In the cases where a large tumor is present, the extraoral attack is to be recommended. In this operation the incision is made in the midline below the mandible and ends of the hyoid bone. Through this incision enucleation is done. In very large tumors the incision is carried downward through the hyoid bone to the upper border of the larynx. When this technique is necessary a tracheotomy must first be done.

There have been no surgical deaths in the cases reported. Healing has been rapid and complete and the patients have quickly returned to the customary employment. It is important to determine the presence of a thyroid at the normal location before operation, in order that myxedema may not be produced by removal of the lingual thyroid.

Fig. 10—Photograph of gross specimen of tongue, showing necrotic area occupying left posterior quadrant of tongue and extending down to epiglottis.

Fig. 8—Roentgenogram of chest of patient August, 1921, showing metastatic tumors in both lungs.
Fig. 9—Roentgenogram of chest of same patient August, 1922, showing great increase in number and size of metastatic tumors in lungs.

Case Report

The following is a report of the case under discussion:

Diagnosis: Aberrant thyroid gland in the root of the tongue which has undergone malignant degeneration. March 23, 1921—Metastases in the lung.

Chief Complaint: Difficulty in swallowing.

Past History: Patient had never been incapacitated.

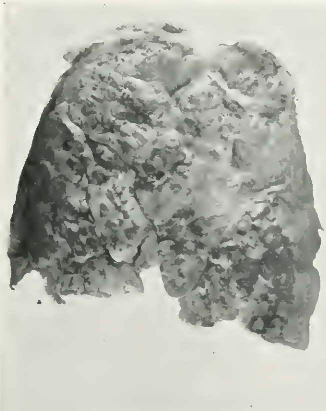
Present Illness: Eight years ago the patient first noticed a small lump at the base of the tongue. He went to a doctor and received local treatment for a while. The lump did not cause any discomfort, because no larger and so he neglected it until five years ago, when he was operated upon. An incision was made on the left side of the neck below the mandible and something removed which was believed to be an enlarged gland. February 12, 1920, he was again operated upon. This time the incision was made in the middle line under the chin, above the hyoid bone. The patient was told he had a goiter in the root of the tongue.

Physical Examination: A tumor mass hard and fixed at the base of the tongue on the left side.

X-Ray Examination: March 23, 1921. Many small areas of increased density definitely circumscribed, ranging in size from a pea to a small orange, numbering more than thirty, scattered throughout both lungs. August 15, 1922. There are several hundred small areas of consolidation throughout both lungs, probably metastatic from the tongue.

Treatment: *Surgical*—On February 12, 1920, an incision was made in the middle line of the neck beneath the chin, in order to gain access to the midportion of the tongue for the purpose of scooping out with a curette, a fragment for microscopic examination. Microscopical examination proved the tissue to be thyroid with hyperplasia. *X-Ray*—At intervals from March 16, 1920, to October 23, 1922, the patient was given x-ray therapy over the mediastinum, neck and abdomen through various ports of entry. *Radium*—June 20, 1920—400 milligram hours of radium was given to the tongue, using 1.5 millimeters brass filter.

Result: Metastases in the lungs, and retroperioneal glands. Patient died.



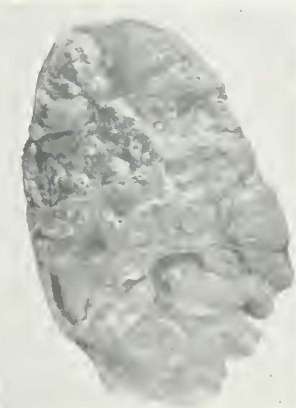


Fig. 11—Photograph of lungs showing multiple nodules studding surface.
Fig. 12—Photograph of cut surface of lung showing multiple tumors in section.

Postmortem Findings: Dr. B. C. Russum. There was a necrotic area three centimeters in diameter involving the posterior portion of the tongue from the middle back to the epiglottis, and from the left margin well toward the right margin (Fig. 10). The lungs were studded with multiple areas of new growth varying in size from one millimeter to ten centimeters in diameter (Fig. 11). Cut section of the lung showed these areas well distributed throughout the lung (Fig. 12). There were many enlarged glands along the spine in the mediastinum. The abdominal viscera were negative except for many scars on the parietal peritoneum and mesentery. There were no enlarged glands.

CONCLUSIONS

1. Lingual thyroid is a tumor in the root of the tongue due to a failure of the thyroid to entirely migrate to its normal position during embryonic development.
2. Histologically and clinically, it has the characteristics of the thyroid.
3. It is most frequently found in women, 40 to 5 being the proportion in reported cases.
4. It may undergo malignant degeneration and metastasize through the blood stream.
5. Surgical enucleation is the best treatment.
6. X-ray and radium treatment is beneficial in cases where surgical removal is impossible or where malignant degeneration has occurred.

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Cancer From The Surgical Standpoint*

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AS FAR BACK as the history of surgery reaches, surgeons have considered cancer curable in the early stages of the disease, and entirely hopeless after metastases have formed.

The statement concerning cancer which is attributed to Celsus, who lived before and during the beginning of the Christian era, has remained a surgical truth during all of the past centuries. He is quoted as saying "Only the beginning of a cancer admits of a cure; but when it is once settled or confirmed, it is incurable and the patient must die under a cold sweat."

It is a fact that when we recall the cases in our personal experience we must agree with Celsus, because it is only in those cases in which we can remove the entire growth that we can hope for a permanent cure.

There are certain regions of the body in which this is less difficult than in others, and it is in these regions that the surgeon has recorded most of his successful cases.

Again, there have been certain forms of surgical treatment which have been more certain to remove all of the cancerous tissues in these early cases.

The proportion of permanent cures in cases in which I have removed the tumor by means of the actual cautery has been much greater than those in which I have used the knife, and the only apparently hopeless cases in which I have observed a permanent cure are those in which I destroyed the tumor and the surrounding tissues with the cautery, with the exception that since we have employed x-ray and radium we have had quite a series of apparently hopeless cases in which, up to the present time, there has been no recurrence, and a number of these cases seem to have resulted in a permanent cure.

There are four very distinct reasons why the removal of an early cancer by means of the actual cautery, preferably a red-hot soldering iron, should result in a higher percentage of permanent cures than the removal with the knife.

1. The heat is carried far beyond the point at which the tissues are severed and consequently the cancer infection which may exist beyond the line of incision is likely to be destroyed by this heat.

2. We know that if one takes a piece of cancer tissue from the breast of a mouse, cuts it in halves, transplants one piece fresh and heats the other to 160 degrees Fahrenheit before transplanting it, that the former will grow while the latter will not. It is plain, consequently, that the tissue outside of the cut surface, which has been exposed to the red-hot soldering iron, is not in a condition to act as a cancer graft, while if the tumor is excised with the knife, any portion of the infected tissue beyond will be sure to grow.

3. A knife passing through tissue infected with cancer may act as a means of carrying cancer infection into portions of the non-infected wound. Undoubtedly, the recurrence of cancer in the form of nodules in the scar, following excision of the breast for cancer, is due to implantation of cancer particles with the knife during the operation.

4. In operating with the knife, one is constantly tempted to take away as little tissue as possible, in order to secure a cosmetically perfect result.

One can readily see to what extent these conditions will reduce the chances of thoroughly eradicating a circumscribed cancer infection in case the knife is used in place of the cautery.

Personally, I have been convinced for many years as a result of my clinical observations that cancer is due to a specific infection.

The experiments of John Nuzum which resulted in the isolation from human cancer of a micrococcus which could be cultured and injected in the form of pure culture into the breasts of mice and dogs, who later died from metastatic cancer from which the same microorganisms could be isolated, have still further confirmed me in this belief and have convinced me that the cautery is far superior to the knife for the removal of malignant growths.

It is possible that still better results may be obtained by the use of diathermy, but my experience with this form of treatment is not sufficient to entitle me to an opinion.

We have repeatedly removed carcinomatous breasts or tumors of the neck with the red-hot soldering iron, and

* Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 5, 1922.

have dissected the axillary or cervical lymph glands with the electric cautery in cases which seemed hopeless and there has been no recurrence for many years. In all these cases, however, the patients have had after treatment with x-ray so that we cannot be certain about the part each of the two methods had in preventing recurrence.

During the past few years so much progress has been made in determining the proper dosage of x-ray and radium by those who have studied the subject, both from a scientific and an experimental side and from extensive clinical observation that I have considered it best to place the radiologic treatment of my cancer cases entirely in the hands of Dr. Henry Schmitz, an expert radiologist. At the same time, I have never ceased giving these cases my continued interest, because it seemed important to give them the benefit of experience obtained throughout years of observation covering hundreds of cases. I have found that our combined judgment has been valuable to both of us, and it seems that in time such teamwork must bring results.

So far, then, we feel certain that quite a number of lives have been actually saved by wide excision preferably by means of the actual cautery and that many of our patients are alive today who would have died years ago had they not been treated with radium and x-ray, either combined or singly.

At the present time we feel that we should treat all cases of malignant growths with x-ray before operating.

We are not certain whether it is best to operate immediately after the patient has recovered from the depressing effect of deep x-ray therapy, or to wait several days or weeks following this time. At present, in all cases in which it seems as though the patient has a chance for a permanent recovery after the removal of the cancer, we operate within a week after the patient has recovered from the depressing effect of the x-ray or radium treatment.

In many cases we have given several courses of x-ray treatment at intervals of from six to sixteen weeks following the operation. A number of these cases are alive after from five to sixteen years.

Since using a more powerful machine we have usually given only one prolonged treatment following the operation. We are not certain as yet whether this plan excells the other.

In some cases it has seemed as though patients who received one prolonged intensive treatment before the operation and none after were more likely to remain free from recurrence than those who were treated before and after.

It seems wise not to be too positive as yet regarding the adoption of any definite method until all methods have been thoroughly tried in a very large series of cases.

Following the very extensive excision that we make we observe the case for years in order to discover local recurrence very early, because we have learned that by destroying these immediately with the actual cautery it is sometimes possible to eradicate the cancer infection, while if the recurrent nodule attains any considerable size before it is destroyed with the cautery, the patient is almost certain to die of metastases.

Early Operation

Many years ago I had a number of experiences which impressed themselves forcibly upon my memory.

I recall a number of cases which came to me so early that with my present experience I am morally certain that they could have been permanently cured if the growth had been promptly removed with the cautery, or in early cancer of the uterus, if the organ had at once been freely removed preferably by severing the vaginal attachment with the cautery.

In these cases three blunders resulted in the death of the patient:

1. Waiting to make certain that the diagnosis of cancer was correct. By the time this was accomplished, metastatic infection had occurred and the case was hopeless.
2. Scrapings or sections of the suspicious tissue were examined microscopically. At that time these specimens were removed with the knife or the curette. These patients died regularly from metastases. Not a single case in which the scrapings or the piece excised with the knife showed the presence of cancer has escaped death as a result of metastatic infection.
3. The tumor was removed with the knife, care being taken to obtain a good cosmetic result. These patients had local recurrence and later metastases, and they all died.

The unfortunate circumstance lies in the fact that these blunders were made in just those cases that had almost a perfect chance for permanent recovery had they been treated decently.

Excision of portions of suspicious growth to confirm a diagnosis of malignancy has been insisted upon by some and condemned by others and the arguments on both sides are so well known that they need not be repeated here. The only case in which I am willing to expose the patient to the danger of dying, as a result of metastases caused by diagnostic excision of a portion of a growth suspected of malignancy, is when the removal of the growth would result in the unnecessary sacrifice of a limb or an important organ or would produce an extensive deformity. In such cases the piece removed should be sufficiently large for a positive diagnosis, and the removal should be accomplished by the use of the electric or the Paquelin cautery so that the lymph channels and blood vessels will be sealed, and will not carry cancer fragments to distant parts. Moreover, in these cases, in my opinion, it is better to remove the entire tumor so that portions from different parts can be taken for examination, because frequently microscopic sections from one part may fail to show malignancy in growths in which other portions are plainly malignant.

Moreover, the examination should be made at once, and if the result does not absolutely establish the fact that the growth is benign, the operation should be completed at once. In my experience, many cases in which the benignity of a growth could not be established positively by the preliminary microscopic examination, have proved to be malignant on thorough examination. In many excisions of early cases of cancer I have for many years followed the rule to remove at the first operation as much tissue as one usually expects to remove after the first recurrence following the primary operation without regard to the cosmetic result. As a matter of fact, it does not matter much how badly the wound looks after a really extensive removal. One can always get a better cosmetic result later on than one can following an operation for recurrence.

If one recalls the saving of the ancients regarding epithelioma "Be unwilling to touch me" (nolle me tangere) it is easy to understand why one should make an extremely wide excision, and also why this excision should be made with the cautery.

The ancients had observed that these skin cancers were fairly certain to remain stationary for a long time if not touched, and that when once started in their growth the case became hopeless.

How often have we not seen a pigmented nevus remain apparently perfectly harmless until it was accidentally crushed or incompletely removed when it would spread violently, producing great numbers of metastatic tumors which would in a relatively short time destroy the life of the patient?

All tumors in their incipiency seem to have a surrounding area which prevents their invasion of adjacent tissues except by very slow infringement. Let this immunizing area be disturbed by a trauma or by the surgeon's knife, and there is at once rapid progress with the formation of metastases.

We saw this early in my experience. Some thirty years ago when osteopathy first appeared many cases of cancer of the breast that came to the hospital had had their tumors manipulated vigorously by the osteopathic practitioners, and most of them had metastatic tumors when they came to our clinic. Later these practitioners learned not to manipulate apparently malignant growths, and as a result this complication became less common.

In our enthusiasm over results of treatment of early cases of cancer, we must not forget the far greater importance of seeking for means of prevention.

In order to appreciate the importance of this, we must try to visualize the ravages of cancer in this country.

We are paying billions of dollars for our portion of the expenses of the late war and other billions to prevent future wars. The number of deaths from wounds inflicted upon American citizens in the late war was somewhat less than 50,000. The number of deaths from cancer since the close of the war has been more than 300,000 in the United States, according to reliable statistics.

Unless we find some means of preventing cancer we must expect to lose a number of citizens of the United States every single year, greater than the total number of lives lost in our army during the late war.

A portion of this loss can be eliminated if we continue our propaganda, so that a constantly increasing proportion of cases come under our care before metastases have formed, and the family physician and surgeon appreciate more and more the harmful effect of temporizing, and the great importance of making an absolutely radical removal the moment the patient comes for examination. The appreciation of the whole profession of the value of x-ray and radium applied according to the directians of a competent, thoroughly scientific, experienced radiologist will help greatly in saving many cases that are now hopelessly lost.

Speaking of cancer from the surgeon's standpoint, I would suggest the following conclusions:

1. The most important work the surgeons and the whole medical profession can do is to develop methods for the prevention of cancer.
2. Eliminate all sources of irritation.
3. Eliminate all sources of filth.
4. Eat only clean food or cooked food.
5. Encourage patients to come early for examination.
6. Make a careful, thorough examination in every case.
7. When in doubt, remove the growth as thoroughly as though you were not in doubt.
8. Remove a malignant growth at the primary operation as widely as you would expect to remove it after the first recurrence.
9. Use the actual cautery whenever it can be used.
10. Always work in conjunction with a competent radiologist.
11. Observe every patient at stated intervals after the operation, and destroy any recurrent nodule at once with the cautery or with radium.

Newer Investigations of Gamma-Ray Dosage of Radium*

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FOUR years ago I published my first paper[1] on methods and results of γ-ray dosage measurements. I attempted in that paper to replace by a simple and direct method the purely empirical and consequently inaccurate dosage of radium then in vogue. The method of measuring was published in full at that time in *Strahlentherapie*,[2] and a year ago appeared in English in the appendix of *Principles of Physics and Biology of Radiation Therapy*, translated by Schmitz[3]. The doses computed by this method have given uniformly consistent results since its publication, for instance, Professor Schmitz and Dr. Bachem showed good results obtained from dosage calculated according to this method.[4]

Since the first publication I have made a series of measurements with different combinations of capsules, partly in cooperation with Professor Friedrich and Mr. Huth at the Freiburg University. I am indebted to Mr. Huth for the drawings shown in the following pictures. The object of this paper is to give you a short report of these later results.

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 6, 1922.

Before coming to this report I should like to emphasize the fact that the solution of the purely physical questions is not the complete solution of the whole dosage problem. The biological factors are of prime importance, but hitherto results based purely on biological research have not given a correct idea of these factors. But this objection does not affect the physical factors which are capable of fairly accurate determination. I think we must apply all the known physical data as exactly as possible if we wish to solve the biological questions. When these questions have been solved then we will be able to measure exactly how they modify the physical dosage.

I.—Measuring Apparatus

For the sake of completeness permit me to briefly review the type of measuring apparatus. This apparatus appears in the upper right hand corner of the first figure.

Of especial importance is the small ionization chamber "K" which measures in connection with the Wilson electrometer "E" the distribution of the dose around the radium capsule "Ra" at every point of the radiated medium. In order to be able to apply the measured doses directly to the tissues a water phantom was used, water and the average human tissues having, as you know ,about the same absorption and scattering properties. All possible errors in the measurements were taken into account and the readings corrected as accurately as possible.

II.—Measuring Results

Let us pass at once to the results:

(a) Scattered rays. First, it was observed, as in the case of roentgen rays, that in the case of the application of radium, the scattered rays arising in the medium cause an increase of the direct dosage. Consequently, the calculation of the distribution of the dosage here, as with the application of x-rays, from the laws of distance and absorption alone, is incorrect.

(b) Isodoses. It was therefore necessary to measure the total dosage distribution entirely around a given radium capsule or around combinations of several capsules. All the succeeding diagrams (Fig. 1 and Fig. 2) show the distribution of the dosage in one plane, from capsules built according to our own specifications, viz., length 25 mm., diameter 3.5 mm., in a silver container evenly filled and with a filter of 1.5 mm. of brass in order to have practically only γ-rays.

Those points at which in a given time equal doses are delivered are con-

nected. The resulting curves of equal intensity in a given time I designated four years ago as *isodoses*. In order to have a distinct picture and one which can be used under all circumstances, all the doses have been calculated in percentages of the isodose 100 at the distance of 1 cm. from the center.

In the diagrams you see the isodoses of one capsule; of two, one behind the other; of three, one behind the other; and of two and three, side by side; cross sections of all combinations and the longitudinal section of the last mentioned combination.

III—Practical Conclusions

What may one immediately learn from these curves?

(a) The points of equal doses do not run parallel with the surface of the capsule, but show characteristic deviations. These are caused by the absorption relations in the radioactive material and in the filter. A special deviation to be noted here is that at the end of the capsule the dose delivered to the adjoining tissues is only about half of the dose which is delivered in a given time at the midpoint of the capsule; the ends are not, as is often supposed, the site of the higher doses.

These findings as measured with the ionisation chamber have been questioned. For instance, I recall here my discussion with Rolf Sievert in the *Acta Radiologica*. Therefore, I tried to prove the correctness of the measured form of isodoses by means of a combined photographic method (x-ray and radium) in which points of equal blackening were connected. In the upper left hand corner of the first figure you see one of the resulting diagrams. We see the same characteristic form of isodoses.

The further away, the more equal the relations become, as is already known theoretically. With the combination of the capsules there is a much more even distribution. For practical use, combinations are therefore to be preferred under conditions to be hereafter explained.

(b) The isodoses enable one to determine immediately the exact dosage delivered at every point of the rayed medium. It is not necessary to emphasize the great importance of being able to do this, but I would like to point out how indispensable this information is, for instance, in cases of combinations with intensity curves of roentgen rays, in adding up the total radiation intensity delivered.

Let us take up the practical determination of the dosage from the isodoses. For example, let us take an erythema dose of the first degree, as it is generally understood. At this point I would like to call attention to the fact that there is no definite sharply demarcated erythema dose, cancer dose, etc., on account of the different biological factors involved. We employ these doses only as relative land marks and must leave it to the practitioner to modify them in each specific case. Out of a large number of biological determinations of this erythema dose, and out of our own experiments, we take the average and call that dose the erythema dose, which in the human tissue at a distance of 3 cm. in 3500 mg. element hours produces an erythema dose. In the first chart (Fig. 1) these relations are visualized. At a distance of 3 cm. from the center the isodose is about 13. For all points on this curve the intensity is the same and the erythema dose is produced therefore in 3500 mg. element hours. If one, for example, has one hundred milligrams the erythema dosage here will be reached in 35 hours at all points at this isodose line. If we go over to points which are nearer to the middle, for example, at a distance of 1 cm. from the center, there we have the isodose 100. For all points on this line we will have an erythema dosage in the thirteenth one hundredth part of 3500, that is, in about 450 mg. element hours, or, in the case of one hundred milligrams we used, for example, in 4.5 hours. Likewise, at a distance of 2 cm., where the isodose is 30 we have the proportion thirteen-thirtieths of 3500, which is about 1500, or in our example, 15 hours.

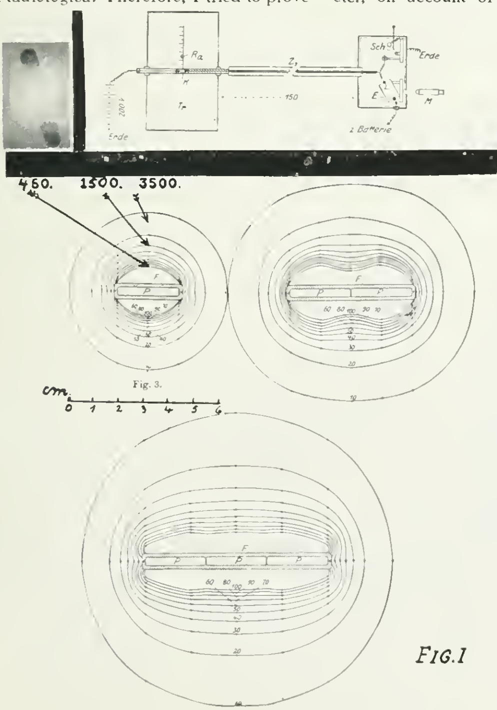
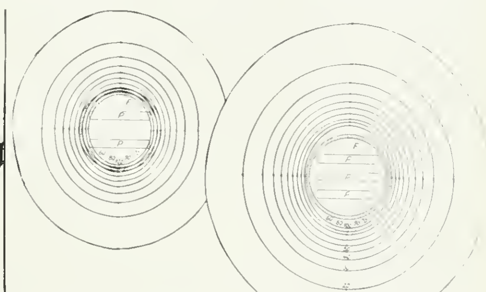


FIG. 1

Distribution of the Doses at a distance of 2.5cm from the middle of the var. arrangementa:

1 capsule	100
2 equal cap. one behind the other I.	165
2 equal cap. side by side II.	262
3 equal cap. I.	229
II.	417



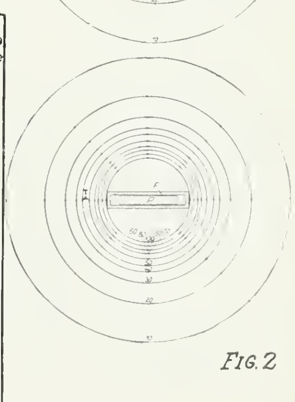


FIG. 2

Out of these few examples, which, of course, could be considerably extended, it can readily be seen that it is possible to compute in advance a pretty exact physical dose for every point in the tissue.

(c) Let us continue with the dosage distribution in the various combinations. We see from the other charts the paths of the isodoses and recognize that the determination of the dosage is exactly as above described in the case of one single capsule. However, as already mentioned, a special point must be noted with these combinations. Therefore, measurements were made by Mr. Huth at a distance of 2.5 cm. from the middle of the capsule with one capsule and with combinations of two and of three capsules. The dosage measured at this distance from the center of one capsule we arbitrarily called 100. Then measurements were made with the two and the three capsules at the same distance and the doses were compared with the findings of the single capsule. In the table of Figure 2 the very interesting findings are recorded. If two capsules are used in the same given time we do not have double the dosage, viz., 200, but in the case of the superimposed capsules only 165 (on account of the absorption conditions) but when the capsules are side by side we have instead of 200 the dose 262, due to the overcrossing of the rays. When three capsules are used the results are still more striking. Let us illustrate the importance of this fact with an example. If a 100 mg. capsule gives an erythema dose in thirty hours at a distance of 2.5 cm., then the same result will not be obtained in half the time, fifteen hours, with two capsules, but in about eighteen hours, if the capsules are superimposed, and in about eleven and one-half hours if they are placed side by side. Thereby the characteristic isodose form is not changed, but only the time of application.

How can the radiologist apply these results to his specially prepared specimens of radium. The shape of the capsule and the filter used are important factors in determining the form of the isodose, the strength of the preparation plays no part in the form of the isodoses. Since all values are relative they can therefore be computed for any number of milligram elements. If the size and shape of the container are the same as those used in my work the values may be used without modification.

If the shape and form of the containers are considerably different, then the larger scientific institutions must compute the isodoses for the respective containers, or perhaps the larger radium companies will make these important measurements.

In conclusion, I would like to mention that the isodoses of radium emanation bulbs are entirely different, on account of the small absorption in the gas. The form of the isodoses must here be more even and almost parallel to the surface of the container. These latter measurements are now being worked out, and the detailed report will follow. Likewise, we will endeavor to show to what extent the physical dosage must be modified by biological factors. But even if these latter questions are of prime importance we must first follow the path of exact practical physical dosage. With these results and with numerous biological facts to be gathered we hope to approach the true nature of the essential biological effect and eventually we will be able to determine the absolute dosage. In this connection I wish to refer to the division of the whole dosage problem into the branches of practical (relative) dosage and of scientific (absolute) dosage, as proposed by Professor Friedrich and myself for x-rays. This subject has already been referred to in our papers on the x-ray dosage problems which were read at the September, 1922, meeting of the American Roentgen Ray Society in Los Angeles. We there showed the experiments and propositions of this problem and explained that it is the purpose of practical dosage to give the radiologist means and methods of calculating and measuring the quality and quantity of rays at every point in the radiated medium. He then can reproduce and repeat every desired effect physically. Absolute dosage seeks to explain the essential biological effect of rays and based upon this to construct the ideal absolute dosage measuring apparatus from these effects.

The solution of this very important problem of ray dosage is now our chief aim.

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Duodenal Regurgitation*

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DUODENAL regurgitation, the subject of my paper, first came to my notice while I was examining the duodenal cap in a case of duodenal ulcer. Later the thought occurred to me that this phenomenon might be a contributing factor in the gastric retention seen in the chronic obstructive type of duodenal ulcer. On general principles I have watched for its occurrence in all kinds of cases and am presenting my observations for your consideration.

*—Read at the Annual Meeting of the Radiological Society of North America, Detroit, Dec. 7, 1922.

Duodenal regurgitation as it occurs within the duodenum itself is not the type of regurgitation I mean. The following study is restricted to duodenal regurgitation into the stomach.

A brief review of American and foreign literature has revealed no previous roentgenological publication on this subject. Some references in experimental physiology were found in Alvarez' *Mechanics of the Digestive Tract*, and since, Pawlow's researches extensive references are to be found in clinical literature. In fact, these clinical references are so numerous, especially within the last ten years, that roentgenologists are made conspicuous by their silence. Of special interest is Alvarez' statement that, "particularly toward the close of gastric digestion there is normally some regurgitation of the duodenal contents into the stomach," so that this point was given especial attention in these studies.

The method of investigation is otherwise not changed from our routine examination. The patient is given, without any further preparation, first a barium water, then a barium milk suspension (recently malted milk), seldom with the stomach empty and often after mixed meals containing even fried pota-

toes, as well as other varieties of food. It is very seldom necessary for the patient to take cathartics, a practice which we discourage during examinations. Some of our patients had been starving for twelve hours, but longer starvation periods were not sought, though Alvarez mentions starvation as causing a lowering of gastric tone and so permitting duodenal regurgitation.

The examinations have been carried on for a full year and the observations on all patients were noted. We have remarked upon the same discrepancy which Alvarez noted when he said: "If reverse peristalsis is so common, why do we not see more of it?" In this series of 190 cases examined from August, 1921, to October, 1922, we have encountered duodenal regurgitation only nine times, 4.7 per cent, and since it is on one hand a normal occurrence, but on the other a rare roentgenological observation, it is questionable whether its occurrence has been correctly estimated.

The clinical significance of duodenal regurgitation is not yet understood, but we do know that it is effected by the contents of the duodenal cap flowing back into the stomach. Whether this takes place through increased intraduodenal pressure, "ring like constrictions" (similar to those described by Carmen in the discussion of stomach emptying, in his second edition) or some other modus is yet to be determined. That the presence of hyper-peristalsis in the stomach has no lessening effect on regurgitation is shown by a recently studied case of obstructive duodenal ulcer with a very large stomach containing a good sized six hour residue. Here it was seen very definitely that the gastric contents were driven back across the empty pouch, in the supine posture, into the body of the stomach by the deep, slow moving waves, yet at the same time duodenal regurgitation was seen to take place quite frequently. Later, it occurred to me that the back flowing gastric contents possibly exerted suction on the duodenal contents in the cap, while the pylorus was open and the contracting cap drove the contents back into the stomach. How often this happens normally has yet to be determined.

The amount regurgitated at a time may be very small, but, as one case taught us, the total may be quite a good deal. In this instance, the stomach was two-thirds empty at the end of three hours and nearly full again at the six hour period. Besides, the patient vomited repeatedly during this time, so that the stomach contents were only a part of the total amount regurgitated.

In spite of its small amount, duodenal regurgitation must be considered as a contributing factor in gastric retention, when seen in cases without organic obstruction at the pylorus, even though the gastric residue may be primarily due to either delayed or infrequent pyloric opening, prolonged or continuous spasm or lowered intragastric or lowered intraabdominal pressure, so-called atony.

The conditions under which we find duodenal regurgitation are quite varied. In the case of duodenal ulcer, previously mentioned, the diagnosis of which was verified at operation, and likewise in a case of presumptive pyloric ulcer with a large ten hour residue, which has not yet come to operation, duodenal regurgitation was noted. In the last named case the pylorus opened promtply and regularly, but the regurgitation was so complete as to leave the duodenum quite empty at the end of the first half hour. In this, as well as all other cases in which duodenal regurgitation was observed, it was found to occur throughout the whole period of gastric digestion.

Recently I noticed regurgitation in a case of duodenal obstruction. This obstruction was situated at the dependant portion of the descending part of the duodenum and was best seen with the patient standing. Regurgitation, both from the point of obstruction to the cap and from the cap into the stomach was noted and was continuously present during the entire time of observation, in the beginning, as well as toward the end of digestion, but less marked with the patient in the horizontal position. A kink was possibly caused either by adhesions from the gall-bladder region or by traction from the ileocecal region, there was a chronic appendicitis. Therefore mechanical as well as chemical agents must be factors in its occurrence.

In another case, that of a child, duodenal regurgitation was observed under great emotional stress, the nervousness of the parents frightening the child who was subject to epileptic fits. This child at first absolutely refused to take the barium water and was induced to do so only with the greatest difficulty.

In a boy of twelve, duodenal regurgitation followed immediately on the intake of the barium and the duodenum remained empty for the following half hour. A few days later this boy developed jaundice, which cleared up under medical treatment. In this connection it is well to remember Alvarez' warning that "as the presence of bile in the stomach is normal, any excess need not indicate disease of the liver so much as an increase in the normal duodenal regurgitation."

The absence of regurgitation is especially noticeable in cases of diseased gall-bladder where one would expect to find it according to the patient's complaints, and where clinicians maintain it is detected in their examination. In only one case of gall stones verified at operation was duodenal regurgitation found to occur. It was likewise found to be absent in a recent case of cirrhosis of the liver in an alcoholic, although he gave a history of daily vomiting.

In four gastro-enterostomies duodenal regurgitation was not observed at the ostium, although regurgitation in the duodenum from the ostium to the pyloric sphincter and back into the

Drawings illustrating duodenal regurgitation as seen by the x-rays.

stomach has formerly been a common roentgenological observation. In the cases mentioned, however, a pylorectomy was done. We observed that as soon as the proximal loops of the jejunum were filled, the artificial opening closed like a sphincter and thereafter opened only at regular intervals and without a sign of regurgitation.

In acute postoperative distension, the giving of barium by mouth is not advisable; therefore, probably the most common occurrence of duodenal regurgitation cannot be studied. It must also occur with a patient awakening from an anesthetic and vomiting bile. Animal experimentation combined with screen study might be tried successfully.

Gastric lavage, or better, the forcing of the gastric contents up through a stomach tube by abdominal pressure, has yielded in the past the main clinical evidence of regurgitation bile and pancreatic ferment in the stomach. But how was it known that its presence was due to normal duodenal regurgitation or to irritation from the tube? In some patients, retching while passing the tube, and in others its irritation of the gastric mucosa may possibly have brought on duodenal regurgitation which otherwise was not normally present. With the Einhorn duodenal tube or the later perfected Reyfuss tube in the duodenum, the pyloric sphincter is constantly open and does not hold the tube firmly. It is easily withdrawn, as control under the fluoroscopic screen has taught us. Therefore, a backflow along the tube is easily possible.

Clinically, we have the patient's word that he lacks appetite, has a constant flat or bitter taste and occasionally brings up bile stained contents. This fluid may be yellow or green in color, but chemical tests are necessary to verify its being bile. A quick, reliable method is the adding of a few drops of iodine to ether and mixing this with the vomitus. The ether will quickly stain green if bile is present. The vomitus following an abdominal operation is often green, but this does not always signify bile. It is often due to a green algus, as my former associate in Chicago, Dr. Leopold Fraenkel, discovered.

We rarely subject the patient to gastric analysis, because the value of the clinical data thereby obtained is in no proportion to the disagreeable features of the procedure and therefore the relationship of the acid values of the stomach contents to the frequency of duodenal regurgitation has not been determined. The only case treated on in this paper and checked in the labaratory was that of the cirrhosis of the liver, mentioned previously. Here the gastric contents showed no free hydrochloric nor lactic acids and no visible bile. Microscopically it was negative.

As any manipulation of the intestines may start the gradients of irritation traversing both ways, palpation was repeatedly tried in order to induce duodenal regurgitation, but without success. Palpation and pressure often helped to open a closed pyloric sphincter, but it was never possible to force duodenal contents back into the stomach. Case and Groedel's pioneer work on the ileocecal valve was in my mind when I tried to obtain this artificial regurgitation.

Animal experimentation has taught us most of what we know of duodenal regurgitation, and we must look to such men as Alvarez and Carlson for further enlightenment. In the meantime we roentgenologists need not be idle, but should help by contributing the information which we have, as it may be of value in explaining the significance of this interesting phenomenon.

In every case where I observed duodenal regurgitation, I had my associate, Dr. Frances MacCraken, verify my findings; and we were often both misled. The course of the duodenum is frequently hidden behind the stomach, and in many patients even turning the body did not lead to any conclusive demonstration of duodenal regurgitation. Often observations made in the upright failed to concur with those made in the supine and prone positions, but where duodenal regurgitation is reported as observed, it was seen in all postures. Therefore, we roentgenologists may confine ourselves to fluoroscopic screen observations, which are apparently just as reliable as the other clinical tests.

The x-ray examination for duodenal regurgitation should be made at either the three hour residue period, or if the stomach is not empty, at the six hour period.

In each of the nine cases in which duodenal regurgitation was observed I might almost say there was a different pathology present, so that as yet we are unable to surmise beforehand when to expect this phenomenon. On the other hand, its rare occurrence may speak for some mechanical or chemical or neurological disturbance at the pyloric sphincter, in spite of its appearing normally under experimental conditions. What value its recording may have, can be estimated only after many observations by a large number of investigators.

It would also be well to study its occurrence with the patient drugged with morphia and belladonna, and even the opportunity to observe it in alcoholism should not be unobtainable.

In conclusion, I would say that duodenal regurgitation, although occurring undoubtedly under normal conditions, is nevertheless rarely observed by the roentgenologist, and this discrepancy may throw some light on its clinical significance. Only in rare instances may it fully explain gastric retention, in most of these it is only a contributing factor along with the delayed phyloric opening and prolonged pyloric spasm or gastric atony.

X-Rays and X-Ray Apparatus; An Elementary Course*

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THE PENETRATING EFFECT OF X-RAY
VII.

General Properties of X-Ray

76. Without entering at present into a discussion regarding the nature of x-rays, we shall note certain general properties.

(1) *Photographic*—They effect a photographic plate or film in much the same way as ordinary light. The speeds of different makes vary and, for the same plate, the speed varies with the kind of rays used.

(2) *Fluorescent*—X-rays excite fluorescence in certain substances on which they fall. By fluorescence we mean the emission of visible light which continues as long as the x-rays strike the substance. Two applications of this property are made in roentgenology, the first in the use of a fluorescent screen for diagnostic work, the second in the use of intensifying screens for shortening exposures when radiographs are being made. Intensifying screens, which are made of substances such as tungstate of calcium, are placed directly in contact with the sensitive emulsion on the photographic plate or film. Wherever the rays strike the screen, therefore, the bluish (fluorescent) light emitted (which is much more actinic than x-rays) acts on the emulsion and so shortens the exposure to a marked degree. A reduction as much as five to ten-fold is quite normal. Care must be taken to keep the screen clean, for particles of dust will absorb the visible fluorescent light and spot the plate. The exposure may be still further shortened by using films sensitized on both sides along with intensifying screens on each side of the film. "In actual use intensifying screens are mounted in rigid holders called cassettes, in order that perfect contact may be obtained between emulsion and screen" (Eastman Kodak Co.).

In the Impex x-ray photographic plate[1] we have an illustration of an application of the same principle. In this plate still further reduction in the time of exposure is obtained by spreading the tungsate of calcium on the plate itself in a layer directly over the sensitive emulson. By so doing, the fluorescent substances are so much more effective that reductions of the magnitude of twenty-five to thirty-fold are obtained.

*—Received for publication May 17, 1923.

In using the Impex plate the only difference from the procedure with the ordinary plate lies in the necessity of washing off the fluorescent substance immediately before development.

(3) *Chemical and Dehydrating Effects*—X-rays produce a discoloration of certain alkaline salts, liberate iodine from a solution of iodoform in chloroform, and change the color of certain substances such as barium platinocyanide.

(4) *Physiological*—The burns which result from undue exposure of the skin to x-rays, the beneficial effect of the rays on certain skin diseases, the stunting of the growth of young animals, are a few of the many examples of this important property, some further details in connection with which will be considered later.

(5) *Ionization*—X-rays make the air through which they pass conducting, as may readily be shown by placing a charged electroscope almost anywhere near a tube. On sending a current through the tube, it is at once observed that the leaf of the electroscope steadily falls until the whole charge has disappeared. The rays have ionized the air in the neighborhood of the electroscope to an extent which at any given region is proportional to the rate at which the leaf falls. Should the simple experiment be repeated a number of times, each time placing the electroscope at a greater distance from the tube, it would be found that the leaf falls more slowly the further it is removed from the tube. This indicates that the ionization at a local region, and so the intensity of the beam of x-rays is greater, the nearer the region is to the tube.

As the ionization property is the basis of the most accurate methods of estimating dosage when x-rays are used for treatment, the importance of this property cannot be too strongly emphasized. Later, details of suitable ionization chambers will be given; at this place, however, a simple form of electroscope which the writer has found useful in lecture experiments, may be noted (Fig. 76). The leaf is attached to the usual metal support, which however is supported by means of the insulating bead of sulphur S. The whole is enclosed in an earthed metal chamber in one side of which is a window W covered with very thin metal foil. The electroscope is charged by means of a movable rod R which passes through an insulating support to the outside of the box.

(6) *Penetrating Effect*—There are few people nowadays who are not familiar with the fact that x-rays pass through fairly thick sheets of matter which we ordinarily call opaque. A thin piece of wood is almost as transparent to x-rays as window glass is to sunlight. But thin layers of any substance are more transparent than thick, and some substances more opaque than others, and herein lies the basis of the familiar x-ray pictures. Radiographs are just shadow pictures, wherein detail is visible because of the unequal degree to which different parts of the subject photographed absorb x-rays. There are in consequence corresponding differences in density on the plate or film. As the whole application of x-rays both for radiography, and for treatment is bound up with the question of absorption of x-rays, the question of penetrating power will now be considered in detail.

77. It is first of all important to realize that the terms opacity, or opaqueness, or transparency, of a substance to x-rays are very indefinite. An experimental illustration will make the point clearer. Before the window of a charged electroscope (Fig. 76) is hung a sheet of so-called protective rubber. On placing a small x-ray tube a short distance away with target pointing towards the window of the electroscope, it is found that, when the tube is running on moderate voltage, the leaf of the electroscope remains stationary or falls extremely slowly. On using a larger tube, however, operated at higher voltage, the leaf falls in a matter of a few seconds. The rubber is opaque to the first beam of x-ray, but far from it to the second. In other words, x-rays from some tubes are more penetrating than from others.

78. Again, the same bulb when operated under different conditions emits rays which have different penetrating effects. Suppose a Coolidge tube is used, with always the same milliamperage, but at a series of different voltages. Suppose, further, that, for each voltage, the distance of the tube from the electroscope is adjusted so that in each case the leaf falls at the same rate, when the sheet of rubber is absent. If now another set of readings is taken for each voltage, with corresponding distances, with the rubber sheet interposed, it is found that the

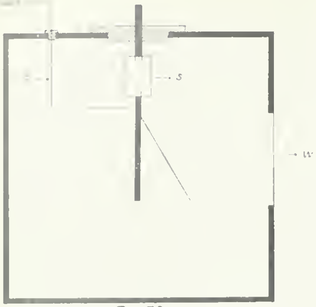

FIG 76

higher the voltage the more rapidly the leaf falls. The conclusion is obvious—the higher the voltage across a tube, the more penetrating the rays emitted.

There are, therefore, different kinds of x-rays which we may describe as *hard, medium, or soft*, according as they are very penetrating, moderately penetrating or feebly penetrating. It will be recalled (Sec. 49) that the same terms are used to describe the state of a gas tube, a hard tube being one in which a higher voltage is required to maintain a certain current than is the case with a soft one. But there is no confusion of terms, for we have just seen that a higher voltage across a tube means an increase in the penetrating power of the rays emitted. A hard tube, therefore, emits an excess of hard rays, a soft tube, an excess of soft rays. But the terms hard, medium and soft are much too elastic for the accurate measurement of so important a quantity as the penetrating power and we must seek some means of expressing degrees of hardness by definite numbers. In other words, we need a scale in terms of which the quality of a beam of x-rays may be expressed.

Means of Measuring Quality

79. Four different methods may be used: (1) Method I, involving a measurement of the voltage across the tube; (2) Method II, in which (a) it is necessary to determine the thickness of some standard substance required to reduce the intensity of a beam by 50 per cent, or (b) the intensity of a beam is measured before and after the insertion of a standard thickness of a standard substance; (3) Method III, in which the absorption of rays by two different metals is compared; (4) Method IV, by the direct measurement of the wave-lengths in the beam or of the so-called "effective" wave length. Each of these methods will be considered in turn.

Hardness by Spark Gap and Bauer Qualimeter

80. Since, as we have pointed out, the penetration increases with the voltage across a tube, the length of the equivalent spark gap may be taken as a measure of the degree of hardness of the rays leaving a tube. The longer the gap, the harder the rays (see Table XIV).

In the Bauer Qualimeter, we find a practical instrument which utilizes this same principle. It is an electrostatic voltmeter which is used somewhat like the voltmeter described in Section 19, and therefore may be placed at any convenient place in the x-ray room. The instrument consists essentially of two fixed plates between which two vanes are free to move. As the higher the potential, the greater the deflection of the movable vanes, this deflection is taken as a measure of the hardness of the rays leaving the tube. A pointer attached to the vanes moves over a scale from which the hardness is read, not in "inches or centimeters of spark-gap," but in a purely *arbitrary* scale with numbers running from 1 to 10. Number 1 indicates a penetration such that the corresponding rays are completely absorbed by 0.1 mm. of lead, number 2 by 0.2 mm. of lead, and so on until we reach number 10 indicating rays completely absorbed by 1 mm. of lead. Numbers 4, 5 and 6 correspond to medium rays, smaller numbers to soft, higher to hard rays.

In the Bauer Qualimeter, therefore, we have the first kind of *penetrometer* which has been used to express the degree of penetration by a definite number. Its usefulness, however, is limited for several reasons: (a) Two bulbs, with exactly the same back-up, will not always emit rays of the same degree of hardness. (b) Again, the hardness of what are called characteristic x-rays (to be discussed later) does not increase steadily with the applied potential. (c) Layers of some absorbing substance are frequently placed between the tube and the place "treated," and these filters, as they are called, alter the mean quality of the rays. It is desirable, therefore, to use more direct means of measuring the penetration, such as we have in Method II.

81. To use this method, layers of increasing thickness of some standard substance are interposed between the x ray tube and some measuring instrument such as the electroscope, and the particular thickness determined which reduces the intensity of the beam exactly 50 per cent. This thickness, which is called the *Half Absorption Value*, is clearly a measure of the hardness of the rays. The choice of a suitable substance depends on several factors, but for work in radiology it is decidedly advantageous to use a substance whose absorption can be compared with that of body tissue. For that reason aluminum, water, and bakelite[2] have been used, although it will be seen directly that aluminum is not satisfactory from this point of view. Here we may digress to ask,

What is the Most Suitable Phantom?

82. A partial answer to that question is found in the work of Kroenig and Friedrich[3] from whose book the measurements given in Tables IX, X XI and XII have been taken.

TABLE IX.

Quality of Rays	Absorption in 5 cm. water	Absorption in 5 cm. meat
I.	80.6 per cent	81.6 per cent
II.	68.4 per cent	70.0 per cent
III.	63.4 per cent	65.4 per cent
IV.	57.7 per cent	59.5 per cent

To compare water with tissue, the extent to which the intensity of four different kinds of x-rays was reduced by a thickness of 5 cm. of water was compared with the reduction by 5 cm. of ground meat. The results are given in Table IX, where I, II, III and IV refer to rays of increasing hardness. It will be seen, for all four of these different kinds of rays, water absorbs within one or two per cent, to the same extent as tissue. In Table X, where a, b, c, d and e refer to rays of increasing hardness, similar measurements are given for water and aluminum.

TABLE X.

Quality	5 cm. water	5 cm. aluminum
a	82.7 per cent	75.1 per cent
b	81.1 per cent	70.2 per cent
c	71.8 per cent	53.4 per cent
d	62.4 per cent	37.3 per cent
e	58.7 per cent	28.2 per cent

In this case, it will be seen that while for the softer rays (class a), aluminum absorbs to nearly the same extent as water, in the case of the most penetrating rays (class e), it is very much more transparent. Now as water has been shown to be a good phantom for tissue for all kinds of rays, it is evident that aluminum is not, especially for very hard rays.

Hardness by Half Thickness Method

83. We return now to a consideration of the second method of measuring penetrating power, the method in which it is necessary to determine the

half absorption thickness D of some standard substance. In Table XI is

TABLE XI.

Thickness of Aluminum	Intensity of Radiation
0	100
1	68.6
2	51.3
3	39.9
4	32.4
5	29.0
6	25.4
7	21.7
8	19.4
9	16.8
10	15.0

given a typical set of readings showing the gradual reduction in the intensity of a beam of x-rays when layers of aluminum of increasing thickness are interposed between the tube and the measuring instrument (such as electroscope). From this table, or the corresponding graph given in Figure 77 it is easy to find out that the value of D, the thickness necessary to reduce the intensity from 100 units to 50 units is 2.15 mm. But if we attempt to describe the quality of the rays leaving this tube by stating that their half absorption value is equal to 2.15 mm. of aluminum, we encounter a difficulty. The same table (or graph) shows that the thickness necessary to reduce the intensity from 50 to 25 units, that is a second 50 per cent, is not 2.15 mm., as might be expected, but 4.32 mm. Evidently the penetrating power of the rays after having transversed the first few layers has increased. The conclusion is obvious—the original beam must have contained a mixture of rays, some more penetrating than others. The first absorbing layers therefore removed a greater percentage of the softer, less penetrating rays, thus transmitting a beam with an excess of harder rays. Now, the same can be shown with reference to the beam of x-rays leaving any tube—there is always a mixture of both hard and soft rays. Stepping up the voltage increases the average penetrating power, but there are always soft rays present.

Filters

84. Because of the fact which has been emphasized in the previous section, it is often necessary to get rid of the softer components. Suppose, for example, deep-seated tissue were being treated with x-rays which of necessity would have to be very penetrating. In such a case the soft rays present would be almost completely absorbed by the skin and intervening tissue, and more harm than good might be done. To remove the soft rays, filters are used, that is, layers of some substance placed between the tube and the place treated. For protecting the skin from very feeble rays, substances such as aluminum, paper, tanned leather, chamois leather, felt, lead acetate lint and sodium acetate lint, are sometimes used. Metallic filters of greater absorption are also used, when it is desired to obtain a beam of fairly homogeneous hard rays. The effect of filters for this purpose will be clear from an inspection of Table XII.

TABLE XII.

Quality	Filter	D for first 50 per cent	D for second 50 per cent
1	None	1.8 cm.	2.25 cm.
2	3 mm. Al	2.4 cm.	2.65 cm.
3	10 mm. Al	3.25 cm.	3.30 cm.
4	1 mm. Cu	3.7 cm.	3.75 cm.

This table gives the thickness of water necessary to reduce the intensity of four different beams of x-rays of increasing hardness; (1) from 100 to 50 units, (2) from 50 to 25 units, with different conditions of filtration. The table shows that rays which have been filtered with 10 mm. of aluminum or still better, 1 mm. of copper, are fairly homogeneous, that is, successive reductions in intensity *of equal amounts* are produced *by equal thicknesses* of an absorbing medium. Such filters completely absorb the softer components.

In such cases the value of D is a fairly accurate measure of the quality of the rays utilized. Even in the case of rays which are far from homogeneous, the half absorption value gives a good idea of the average penetrating power of the beam. For example, rays which have a value of D from 10 to 15 mm. of aluminum are of average

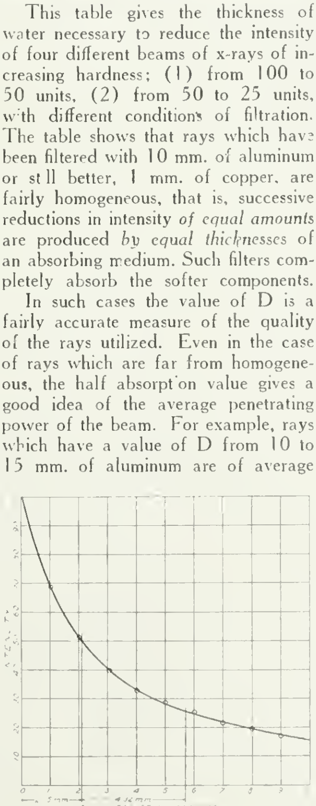

FIG 77

hardness; values considerably greater correspond to very hard rays, considerably less to very soft. Thus, if the same absorbing medium is always used, the values of D obtained for different beams of rays provide a set of numbers for comparing their average penetrating powers. The larger D, the more penetrating the rays.

The Christen Penetrometer

85. It is not always necessary, however, actually to have an ionization instrument and to make intensity measurements similar to those given in Table XI. There are other types of penetrometers for enabling an operator in a very few minutes to obtain at least an approximate value of the penetration. In the Christen penetrometer, for example, the quality is expressed in terms of the half thickness value of bakelit. The beam whose penetration is to be measured falls on a fluorescent screen, after one portion has passed through a perforated lead plate, and another through a bakelit step ladder (wedge). The lead plate contains small holes of such an area that the intensity of the beam is reduced exactly one-half. In actual use a reading is taken of the particular thickness of the bakelit wedge behind which the intensity of the fluorescent light is the same as that behind the lead plate. Obviously this is the required half absorption value, and the quality is at once expressed in terms of this thickness.

A brief reference will now be made to a few other penetrometers, in all of which penetration is measured by means of the third method, that is, by a comparison of the absorption of different metals.

The Benoist Penetrometer

86. This consists (Fig. 78) of a disc about an inch or more in diameter, with a central ring of thin silver, 0.11 mm. thick, surrounded by 10 or 12 sectors of aluminum with thicknesses ranging from 1 mm. to 10 or 12 mm. The general appearance is somewhat like that of a spiral staircase. In actual use, the penetrometer is placed directly over a photographic plate. As each section of the corresponding image obtained on development is blackened an amount which depends on the extent to which rays are absorbed, there is one sector whose image shows the same shade or degree of blackening as that behind the silver center. Should the rays be made more penetrating, a thicker sector would have the same shade. Fig. 79 is a reproduction of an actual photograph, for the use of which my thanks are due Dr. W. D. Coolidge. As the number of the sector which shows the same shade as the inner circle is taken as a measure of the penetrating power, we are provided with another arbitrary

scale of quality, Benoist 1, 2, 3 to 10 or 12. Benoist, number 6 (B-6) for example, corresponds to a medium degree of hardness. This penetrometer depends on the principle that silver absorbs strongly practically all kinds of x-rays used in radiology.

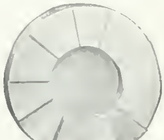

Fig. 78 Benoist Penetrometer (Wappler Elec. Co.)

The Walter Radiometer

87. This consists essentially of a sheet of lead, perforated with eight holes, each of which is covered with a sheet of platinum, and the whole backed with a fluorescent screen. As the thicknesses of the pieces of platinum vary in geometrical progression from .005 mm. for hole No. 1 to .64 mm. for hole No. 8, the more penetrating the rays the greater will be the number of fluorescent spots observed on the screen.

The degree of hardness is therefore measured by the number of the hole corresponding to the greatest thickness of platinum penetrated.

The Wehnelt Crypto-Radiometer

88. In principle this is similar to the Benoist Penetrometer. Behind a lead plate with a vertical slit is placed a fluorescent screen. In front of the slit is placed a flat strip of silver and a *wedge* shaped strip of aluminum, both of which may be slid along in a horizontal direction. Rays falling on this radiometer pass through the silver and the aluminum, thus causing the screen behind the vertical slit to fluoresce. The penetration is measured in terms of the thickness of the aluminum wedge behind which the intensity of fluorescence is equal to that behind the silver.

Fig. 79

89. As the use of both the Walter and the Wehnelt penetrometers depends on visual observation of a fluorescent screen, it should be evident that care should be exercised that the lead plate provides ample protection for the observer. (See Sec. 91).

Comparative Values of Various Penetrometers

90. As in the different means of measuring penetration which we have been discussing, purely arbitrary scales are used, it is highly important to be able to compare one scale with another. For example, in the Wehnelt scale, what corresponds to Benoist 7? The answer will be found in Tables XIII and XIV, in which comparative values are given, one set after Knox, the other after Christen.

TABLE XIII.

Table of comparative values of various penetrometers (after Knox)

	Soft				Medium					Hard
Bauer	1	2	3	4	5	6	7	8	9	10
Kehnelt	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15
Walter	1	1–2	2–3	3–4	4–5	5–6	6–7	7–8	....	..
Benoist	1	2	3	4	5	6	7	8	9	10

TABLE XIV.

Table of comparative values of various penetrometers (after Christen)

Half-Value Layer in cm.	Wehnelt	Benoist	Walter	Bauer	Spark gap in cm.
0.2	1.7	1	–	1.1	1–4
0.4	3.2	3	4	2.2	3–6
0.6	4.8	4	5	3.2	5–10
0.8	6.2	4	5	4.1	6–12
1.0	7.5	5	6	5.0	7–15
1.2	8.8	6	7	5.8	8–18
1.4	9.8	7	8	6.5	12–25
1.6	10.6	8	8	7.1	———
1.8	11.3	8	–	7.5	———
2	11.9	9	–	7.9	———

Protection

91. Before discussing the fourth method of measuring penetration, we shall digress again briefly to discuss the subject of protection. We have seen that with increasing voltage goes an increase in the penetration of the rays emitted by a tube. In other words, as we have already noted, a substance may be absolutely opaque to rays from a tube on low voltage, and comparatively transparent when much higher potentials are utilized. With the high voltage machines now available, it is possible to obtain x-rays which will penetrate 4 to 5 mm. of lead, or 7.5 cm. of steel or iron. Indeed we have an industrial application in the use of x-rays to detect the presence of flaws in steel plates, copper castings, etc. It follows, therefore, that with the increasing use of higher voltages, both in industry and in radiology, the importance of exercising the utmost care to guard against undue exposure to x-rays cannot be too strongly emphasized. The penalty which so many pioneer workers had to pay for (in their case) excusable ignorance of the dangers, should be a warning to all beginners in x-ray work.

Protection is necessary not only because of danger of burns and allied troubles resulting from undue exposure to the rays, but also because of the danger of contact with high tension wires and apparatus, as well as from noxious fumes developed in the x-ray room. What some of the necessary precautions are, may best be given by quoting from the report of the x-ray and radium protection committee of Great Britain. [4, 5].

Ventilation

"1. It is strongly recommended that the x-ray department should not be below the ground level.

"2. The importance of adequate ventilation in both operating and dark rooms is supreme. Artificial ventilation is recommended in most cases. With very high potentials coronal discharges are difficult to avoid, and these produce ozone and nitrous fumes, both of which are prejudicial to the operator. Dark rooms should be capable of being readily opened up to sunshine and fresh air when not in use. The walls and ceilings of dark rooms are best painted some more cheerful hue than black."

Electrical Precautions

"The following recommendations are made:

"1. Wooden, cork, or rubber floors should be provided; existing concrete floors should be covered with one of the above materials.

"2. Stout metal tubes or rods should, wherever possible, be used instead of wires for conductors. Thickly insulated wire is preferable to bare wire. Slack or looped wires are to be avoided.

"3. All metal parts of the apparatus and room to be efficiently earthed.

"4. All main and supply switches should be very distinctly indicated. Wherever possible double-pole switches should be used in preference to single-pole. Fuses no heavier than necessary for the purpose in hand should be used. Unemployed leads to the high tension generator should not be permitted."

Deep Therapy

"This section refers to sets of apparatus giving voltages above 100,000.

"1. Small cubicles are not recommended.

"2. A large, lofty, well ventilated and lighted room to be provided.

"3. The x-ray bulb to be enclosed as completely as possible with protective material equivalent to not less than 3 mm. of lead.

"4. A separate enclosure to be provided for the operator, situated as far as possible from the x-ray bulb. All controls to be within this enclosure, the walls and windows of which to be of material equivalent to not less than 3 mm. of lead."

Full details will be found in the original report.

Where transparency (for visual observation) or flexibility is required, sheets of lead glass or of rubber impregnated with lead may replace lead itself. Such sheets should be considerably thicker than the corresponding minimum layers of lead; in the case of good rubber, from 2 to 4 times as thick, in the case of glass from 5 to 10. Different specimens vary considerably however. Ultimately it is probable that such material will have to be sold with the standardization mark of the Bureau of Standards, or, in England, of the National Physical Laboratory. It should not be forgotten, too, that rubber deteriorates with age, and should be renewed periodically.

The x-ray tube itself should always be covered with protective material except for a small opening through which the beam to be utilized can pass. In addition to the permanent protective shield usually found about a bulb, an extra protective layer of rubber as recently described by Pfahler[6] may well be used.

Penetration and Wave Length

92. The most exact way of describing the quality of a beam of x-rays is found in the fourth method, that is, by giving the wave length or the effective wave-length of the beam utilized. Before this method can be discussed, however, it is necessary to say something about the nature of x-rays.

VIII.
The Nature of X-Rays

93. For many years after their discovery, the exact nature of x-rays was a subject about which there was much speculation. Until 1912 there was ample justification for naming them by the third last letter in the alphabet. In that year, however, as a result of the work of Laue, assisted by Friedrich and Knipping, it was experimentally demonstrated that the phenomenon of interference could be obtained with x-rays, and that consequently they were a form of wave-motion. As the pioneer work of these men opened up a field of research which has led to tremendous advances in our knowledge both of x-rays and of other physical phenomena, it is desirable that all x-ray workers should clearly understand the fundamental ideas of wave-motion.

Everyone is familiar with water waves, as well as with the fact that they may be big, or very "tiny" as in the case of what we ordinarily call ripples. An observer watching water waves at all carefully cannot fail to be struck with two things, (1) crests and troughs repeat at regular intervals, (2) at any place at which he may fix his attention, the water goes through a to and fro motion; a floating block of wood bobs up and down, up and down, and so on. Now, these two features are characteristic of any regular train of waves. At any given instant (imagine a snap-shot photograph taken) the position of particles is repeated at regular intervals, which we call wave-lengths. A wave-length, therefore, is the distance between successive particles whose displacement and velocity with reference to their normal position is the same, or to use the technical phrase, two particles which are in the same phase. In the case of water-waves, from crest to crest, or trough to trough, is a wave-length. On the other hand, if we fix our attention on the particles at any particular place, we see that each particle at regular *time* intervals, comes back to the same position. This time interval is what is called the *periodic* time or briefly the period, although more often we speak of the *frequency* or the number of complete to and fro vibrations per second.

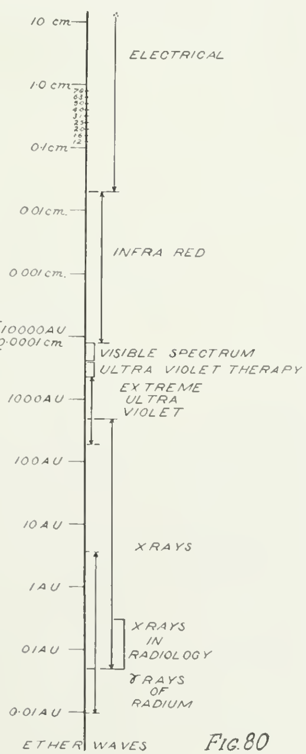

FIG. 80

It is not a difficult matter to prove that the wave-length is just the distance the wave disturbance travels during the time of one complete vibration of a particle.

94. In sound waves we have exactly the same phenomena. As a train of sound waves travels along, the air particles at all places go through a to and fro motion. If we could take a snap-shot of the air, we should be able to see that certain particles, separated by regular intervals, are displaced exactly the same amount from their normal position. Should we take a set of tuning forks all of which vibrate at different rates we should observe something else, and that is, that the wave-length is shorter, the more rapidly a fork is vibrating. Now, everyone knows that a person listening to such a set of tuning forks would hear for each one, a characteristic note of a musical scale. From what has just been stated, however, it should be evident that physically we can describe the different notes by giving either the frequency of the fork (number of vibrations per second) or the wave-length emitted. The higher the pitch of the note, the higher the frequency, the shorter the wave-length. In sound usually we make use of frequency, but it is important to realize that we might describe different notes in terms of corresponding wave-lengths.

95. In ordinary (visible) light we have another important example of wave-motion. In this case, the medium

in which the vibrations take place is the invisible "luminiferous" ether. To visualize what is going on, one may think of vibrations of ether "particles," or may make use of the modern conception that light waves are electromagnetic in character. On this point of view, when a train of light waves passes along there is (1) at any place, a periodic change in the electric and magnetic intensity, while (2) at any instant (compare the snap-shot above) the values of the electric and magnetic intensity repeat at regular intervals, which we call the wave-length. Moreover, just as in sound we have different frequencies and wave-length, so in light we have different colours. These also we describe physically in terms of corresponding frequencies or wave-lengths. Although it is not always the case, in light it is more usual to use wave-lengths. To come to definite numbers, when waves of lengths ranging from approximately 0.00007 cm. to 0.00006 cm. fall on the eye, the sensation of red results. Physically, wave-length 0.000068 cm. is not the same red as, say 0.000065 cm., but the eye probably would not be able to detect any difference. Wave-lengths in the neighborhood of 0.000058 cm. correspond to yellow, and so on down through the ordinary spectrum until we come to violet, corresponding to wave-lengths a little greater than 0.000040 cm.

96. But light-waves are not the only ether waves with which we have to deal. There are waves longer than the longest red, and shorter than the shortest violet. On the long side we have first of all what is called the infra-red region, comprising wave-lengths ranging from 0.00007 cm. to .031 cm. These waves, at least the shorter of them, are sometimes called heat waves because on absorption by a body on which they fall, they give rise to a considerable amount of heat. The name, however, is not a happy one, as shorter waves also on absorption give rise to heat.

Next we have the still longer electrical waves which have lengths nearly[7] as short as the longest infra-red, and as long as those used in wireless. In "Radio," for example, wave-lengths of the order of several hundred metres are used, while we may have electric waves even miles in length.

97. Turning to the other end of the spectrum, we find first of all the ultraviolet region comprising waves which, but a few years ago, ended at 0.00001 cm., but which in the last year or two have been obtained as short as 0.000002 cm. In ultraviolet therapy use is made of the waves in this region from approximately 0.00004 cm. to 0.00002 cm. (For information regarding this field of work, readers are referred to the series of articles recently published in this Journal by Dr. A. J. Pacini).[8] In passing we may note that these short waves are very easily absorbed by matter, a thickness as small as 1 mm. of air at atmospheric pressure absorbing beyond 0.000017 cm. For the measurement of the extremely short waves in this region apparatus with air at very low pressure must be used. Glass itself is transparent only to waves a little beyond the visible violet, and for that reason, quartz (opaque beyond .0000185 cm.) must be used in lamps designated for their ultraviolet output.

Coming to x-rays, we have seen that the work of Laue, Friedrich and Knipping showed that these also are ether waves, usually of wave-lengths much shorter than even the shortest ultraviolet. While the complete range extends from 0.000005 cm. to 0.0000000006 cm., in radiology, the rays utilized have lengths ranging from 0.000000003 to 0.0000000006 cm. Finally we have gamma rays of radium, the shortest known ether waves, with wave-lengths ranging from 0.000000014 to 0.0000000001 cm.

The Angstrom

98. Because of the extreme shortness of both visible and invisible light waves, another unit of length is generally used. This new unit, which is called the Angstrom, is simply 10^{-8} cm., that is, one hundred-millionth of a centimeter. Thus, instead of writing 0.00006 cm., we write 6000 angstroms or 6000 A.U., and the range of wave-lengths used in radiology extends from 0.3 A.U. to 0.06 A.U. Table XV gives a summary of all classes of ether waves with approximate limits, while Figure 80 shows graphically (logarithmic scale) the complete range. It should be clearly understood that, although one class is called electrical, all these waves are of the same character, all electromagnetic. Differences in their properties correspond solely to differences in their wave-lengths. In the next article questions of penetration and wave-length will be discussed and a brief reference will be made to the method of measuring x-ray wave-lengths.

References

1. Levy & Baker: Am. J. Roentgenol., 8:528, Sept., 1921.

2. Bakelit is an insulating material made by hot pressing paper or cloth with raw bakelit, a condensation product of carbolic acid and formaldehyde.

3. The Principles of Physics and Biology of Radiation Therapy, Kroenig & Friedrich, English Edition by Schmitz, Rebman, New York, 1922.

4. Preliminary Report of the X-Ray and Radium Protection Committee in England.

5. Report of the above report included in "Protection in Radiology" by Pfahler, Am. J. Roentgenol., 9:803, Dec., 1922. Abstract of in J. Radiol., 4:96, March, 1923.

6. Am. J. Roentgenol., 8:5, May, 1921.

7. The writer understands that as the result of some recent work not yet published the gap between the electrical and the infra-red region has been bridged.

8. J. Radiol., 3:378, Sept. & 481, Nov., 1922.

TABLE XV.

	Range of Wave Lengths		
Electrical	10^{6} cm.	to	0.08 cm.
Infra-red	0.031 cm.	to	0.00007 cm.
Visible	0.00007 cm.	—	0.00004 cm.
	7000 A.U.	—	4000 A.U.
Ultraviolet in Therapy	4000 A.U.	—	2000 A.U.
Extreme Ultraviolet	4000 A.U.	—	200 A.U.
X-Rays	500 A.U.	—	0.06 A.U.
X Rays in Radiology	0.3 A.U.	—	0.06 A.U.
Gamma Rays of Radium	1.4 A.U.	—	0.01 A.U.

EDITORIAL

The JOURNAL OF RADIOLOGY

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ANNUAL MEETING
Rochester, Minnesota
December 3, 4, 5, 6 and 7, 1923

Dental Radiology

BEGINNING with the January issue it is the purpose of the Journal to include publications of immediate and vital interest to those especially concerned with the dental aspect of the science of radiology.

Two series of articles are under preparation and the first numbers of these have been received at the editorial office Coming as these series do from men of long experience and of unquestioned ability, and written in clean-cut, logical fashion upon subjects of practical interest, they will be of very great value to those especially interested in dental and oral pathology as well as to the general radiologist.

Dr. William Lete Shearer, M.D., D.D.S., F.A.C.S., and Dr. Albert D. Davis, M.D., D.D.S., of Omaha, are joint authors of a series of articles upon impacted and unerupted teeth, root-end pathology, and tumors of the jaws.

Dr. Shearer is a member of the American Association of Oral and Plastic Surgeons and is Oral Surgeon to the Swedish Hospital of Omaha. He is Visiting Surgeon to numerous Omaha hospitals, among which are the Methodist, the Clarkson, the Presbyterian, and Wise Memorial Hospitals. Also he is Instructor in Oral Surgery in the National Post-Graduate School of Orthodontia, Kansas City, Mo.

Dr. Davis is Oral Surgeon to the University of Nebraska Hospital, Omaha, and is also Instructor in Oral Surgery to the University of Nebraska College of Medicine.

The second series is by Dr. William A. Lurie, M.D., of New Orleans. Dr. Lurie has specialized for twelve years upon diseases of the mouth and particularly upon dental roentgenography. His series will deal with the technique and interpretation of shadows on the film, together with the clinical significance of these shadows.

Dr. Lurie has for years held classes in the interpretation of dental films and he has most generously offered to conduct a dental questionnaire in connection with his articles. Readers may ask any question upon Dr. Lurie's specialty and he will answer these questions in the columns of the Journal. Questions to be answered in the January issue of the Journal should be sent in at once to the Journal office, 121 South 33d Street, Omaha, Nebraska.

Chicago Physiotherapy Meeting

IT IS with a good deal of satisfaction that we can report the success of the Chicago Physiotherapy meeting, held at the Logan Square Masonic Auditorium, October 15th to 19th.

Four hundred and sixty-four physicians were registered from twenty-nine states, Canada, China and India. Not a single doctor who was scheduled to appear on the program missed his appointment, and all who attended were highly pleased with the program, as shown by the fact that none of them missed any of the lectures. Many men who had come into Chicago in advance of the meeting of the American College of Surgeons, came out the first morning and were so well pleased that they remained for every succeeding lecture.

It is a significant fact that, without a dissenting vote, the men there present passed a resolution to join the American College of Radiology and Physiotherapy. Such a response shows without doubt the wisdom of the formation of the College, indicating as it does the widespread desire of the men engaged in this work throughout the country for some such high class organization. In the past the members of the medical profession have looked with distrust upon the physician engaged in practicing physiotherapy because in America this method of treatment was so universally in the hands of charlatans, but the valuable help which it rendered medicine during the World War has done much to overcome this prejudice, and it seems that now is the opportune time for the medical profession to organize physiotherapy. Only in this manner can the value of this branch of therapy be saved to the medical profession and taken from the realms of the cult and the charlatan. It is much better to work from the inside out than in the opposite direction. The valued work of the American College of Surgeons stands as an ideal toward which the American College of Radiology and Physiotherapy strives in this branch of therapy. That is, cooperation of all men practicing x-ray diagnosis or treatment, radium treatment or physiotherapy treatment.

Let Electricity Figure It Out

DR. GEORGE W. CRILE, a Cleveland surgeon, thinks that man is simply a mechanism run by electricity and chemical reaction. He says electricity is the flame of life burning in some 28,000,000,000,000 cells of the body, each cell itself a tiny wet battery with negative and positive pole.

A few weeks ago, Dr. Francis A. Cave of Boston predicted there would come a time when human beings would absorb electrical vibrations instead of eating food. Recharging the body with energy will be done in the future by apparatus that will connect the body with a supply of electricity, he said.

We do not know whether to feel happy or sad about electricity. Perhaps the currents of electricity that make happiness and sadness did not get the proper stimuli from our meditation. If we could only feed our mechanism a charge of energy for a brain storm, the task of figuring out what man is, might be simple as a piece of mechanism

run by electricity. We find ourselves no closer to knowing what man is than Tennyson was to knowing what the flower in the crannied wall was. To tell us that man is an electrical machine is like explaining death by saying man dies like a dog. But who knows how a dog dies?

So we leave the doctors with their experiments to argue about it and about. And we wonder what the grocers, the butchers, the bakers, the farmers and all the folks who feed us will do if the time ever comes when we shall eat lightning. Gosh, what will the dentists do?"

The above editorial appeared in the Omaha World-Herald, October 24, 1923. What now about the need for education of the laity on medical and scientific subjects?

Service in Radiology

COMPARATIVELY speaking, I am young in the field of radiology; eight years measures the span. The allurement of a new and fascinating method of diagnosis drew me to the field. Diagnosis is the prop upon which therapeutics lean for support. Without diagnosis all therapy becomes empirical. My faith in the new method has been justified. Still I have never come to look upon the diagnostic value of x-ray as more than an important adjunct to the old reliable careful history and physical examination. The attempts of many radiologists to force the x-ray into the exalted position of a court of last resort has brought nothing but discredit and rebuke upon us.

I had not ventured far afield in this new realm of medicine until I became so fascinated with the work that all else seemed of small interest to me in comparison. With increasing interest was born a love for the work that brought with it all of the attributes of love, pride and joy in accomplishment, disappointment and sorrow in its failures and shortcomings, disgust and anger at its abuses.

Naturally, such an attitude looks solicitiously upon anything that influences, favorably or unfavorably, the development of the science. I am sure that most of my associates, and more particularly those who follow the practice of radiology exclusively, share my feelings in this matter. Exclusive practioners and even those who use it merely as a necessity forced upon them by modern medical armamentaria, must have an interest in this very important diagnostic and therapeutic method, and increased success in its mechanical, physical, technical, diagnostic and therapeutic phases brings elation to older workers.

Except for one reason no individual or group of individuals would hamper or obstruct, wittingly, these developments. This reason is personal greed, passion for personal aggrandisement. This is an unpleasant and unfortunate truth. Throughout the entire world of radiology, its progress, its usefulness, its value to both the medical and lay worlds, is being obstructed by that great curse to human progress everywhere and in every realm of endeavor. Selfishness, avarice and greed, the monsters that sacrifice every virtue for their own worldly advancement are responsible for much that now exists in and must be eradicated from the world of radiology.

In the effort to win fame and fortune to themselves individuals, groups, cities, states and nations have followed ruthless methods until today this old world is in a state of chaos that beggars description and I am sure that selfishness, avarice and greed are playing the stellar roles in the etiology of our present world ills. There is a remedy for these ills, there must be, else civilization must totter and fall.

What is true of world politics is true of our profession of radiology. We must subscribe to and follow faithfully the principles of the golden rule and place service in the exhalted position to which it belongs if we are to achieve success. Adequate reward will follow as surely as day follows night or the seasons follow each other in perpetual rotation.

Time was when radiologists were few and equipment was inadequate and difficult to obtain. Much of it had to be acquired by personal construction. Then the pursuit of radiology was largely a matter of interest in a new and fascinating form of physical energy, then men studied to solve a new and difficult problem. It was during that period that the most stable and laudable achievements were made.

Not for long, however, did personal greed withhold its blighting influence from our loved profession, and from then until now radiology has fought this conscienceless mercenary demon. Unscrupulous avarice, greed, and self-seeking service has produced incompetent men, with no real pride or interest in the science of radiology as an ethical profession. These men, having not the slightest idea of how to interpret shadows in terms of pathology, have purchased equipment from short sighted salesmen, and let the full measing of those words be felt. The principal idea with such men is to possess a new office fixture as an added lure, which when kept well lubricated with buncomb will produce a mighty psychologic shock upon the receptive sensorium of a trusting and easily deluded clientele. It is so easy to prove a previously made diagnosis.

Also there has been produced the individual who, although he may or may not know his science well, has foolishly enough made exorbitant and unreasonable claims for x-ray as a diagnostic and therapeutic measure, thereby undermining the confidence that would otherwise be reposed in it, bringing the entire science into disrepute and subjecting it to ridicule.

X-ray diagnosis has made a mighty impression upon the minds of many diagnosticians, as well as upon laymen, even to the extent that they fear to express their own opinions in the presence of the radiologists. This feeling so common today is, I am sure, the result of exorbitant claims made for x-ray by the class of men just referred to. They have for a season succeeded in deluding the average referring physician, but the time is soon to come when these men will awaken to the fact that their most dependable props still are history and physical examination. Referring physicians will expect from the radiologist a report covering only those features of the case that are detectable in normal shadows or alterations therefrom. Furthermore, this report should be a statement of conditions found in terms that may be of use to the internist, or surgeon in many phases of his examination. To illustrate: When an internist examines a stomach he wishes information concerning all its phases—anatomic, physiologic and pathologic deviations. Before the days of x-ray he attempted to detect these things by other methods. We all remember how the stomach was inflated with gas to determine its size and location. This was before the day of x-ray. Now the diagnostic use of the ray furnishes this and other data on a dependable basis. Therefore, your report to him should come back covering those features that the x-ray demonstrates as no other method has done. It should, in the case of the stomach, which we are using for illustration, include details such as size, shape, position, mobility, tone, peristalsis, contour, location of tender points, emptying time, motility, etc. Append your opinion as to existing pathology gleaned from your x-ray examination, and this data, together with other laboratory findings and the information obtained by the internist will constitute the materials from which conclusions as to diagnosis will be drawn.

It is no disgrace and no belittling confession that x-ray is but an adjunct in diagnosis. Come, let us reason together,

radiologists, laboratory men, internists and surgeons, in order that we may render service.

I hope that standardization of x-ray reports may soon be an accomplished fact. I think I see possibilities for much benefit to the science of radiology, to mention but one item, I feel that it would do much toward eradicating the buncomb from x-ray diagnosis.

I hesitate to say that the characteristics mentioned above are responsible for the next type I will discuss. I really think this type is the unfortunate victim of circumstances over which he once had control but now has lost it. I refer to the under-prepared individual who is over-equipped. Commercialism has forced upon us (and here I refer to the mine-run of radiologists and not to the few who are prepared by careful training, long and large experience) "big Berthas" if I may be permitted to use this term, that are so potent for much harm as well as some good in therapeutics. Keenness of competition and the desire to impress the lay public with our stupendous equipment has placed in the field indiscriminately these machines which I feel sure, because of their indiscriminate use, are going to react most unfavorably upon radiotherapy.

Had they been held well in check and kept in proper hands until the development of mechanical, physical and technical details that would have made their use more nearly fool-proof, I can see how the eventual good that is to come from their use would have been ours without the great harm that now is in the harvest.

There are numerous manufacturers of these big guns and their product must be sold. Whether there are gunners trained to use this heavy ordnance is a matter of secondary importance to them. They are forced, through commercial necessity to market their product and the public, the trusting public, must pay the price; and here let me say that lay-publications, in their craving for the sensational, are largely responsible for injecting into the public mind exorbitant claims and false impressions of this startling piece of heavy artillery.

Also here let me plead with our leaders a point that I wish to make. There are in all specialties of medicine men who stand at the head, leaders, if you please, and to these we look for guidance. We listen to them, we read what they write, and they should, respecting the faith and trust we repose in them, be most careful in reporting upon their work. I have had reports from some of these that were misleading to this extent. They told of the good they had accomplished, the beautiful results they had obtained, but had a serious lapse of memory and forgot to mention their bad results and fatalities. When we who have sent these cases in for heavy treatment have had them returned to us in wooden shrouds or in such condition that they soon succumbed, death being due absolutely to over roentgenization, we have felt solicitious and sympathetic, but when later we hear these same men report on their work and forget to mention these fatalitics we become distrustful and disgusted. We come to look upon them as placing their own personal interests above those of the profession in its ultimate development.

Not long since one of the leading internists of the Middle West said to me: 'I have my fingers crossed on the entire proposition of higher voltage x-ray treatment." This, gentlemen, is because of the bad results directly traceable to too much mechanical and too little mental equipment.

Next, it seems necessary to mention that low-bred but altogether too numerous type who seems to feel, that in order to increase one's business and magnify one's qualities one must tear down and discredit every opinion given or diagnosis made by a competitor in the tributary field. We see this spirit too frequently among practitioners in every field of medicine and surgery, and it is due to this that much of the lack of confidence in the profession as a whole results and it may be very largely responsible for the flourishing of sectarian practitioners.

What I am protesting against is the indiscriminate launching of floating bombs in an uncharted sea where no protection is offered to passing ships.

Iust now there is being crowded upon our profession an over-supply of equipment for physiotherapy. It is being grabbed up by every cult practicing the healing art. This is being encouraged by venders of the working tools of our profession who make exorbitant claims as to the therapeutic value of these new office decorations which are really very usful therapeutic measures if properly used, but over enthusiasm breeds unjustifiable claims that will surely bring unfavorable reaction. Time will bear me out in this statement.

Let me quote from a letter mailed out by Drs. Mullins and Spencer:

> "In view of the wide interest in, and the great importance of the various phases of radiology and physiotherapy, and concomitantly, the imperative prerequisite of solid grounding in the science of medicine as a condition of intelligent practice of these branches of the medical profession, this meeting has been arranged—a meeting like which has been long in the minds of the officers of these organizations, but which until now has never been possible of accomplishment. We may say that the impetus given this cooperative idea by the action of the American Medical Association at its latest meeting in San Francisco has been of invaluable benefit to us in completing these arrangements, and will, we earnestly believe, prove a great forward step in *bringing us all nearer the standards to which we aspire.* To quote briefly from the minutes of the A. M. A., as reported in its journal, issue of July 14th, page 120: 'We feel, however, that the Association should recognize the increasing importance of special medical activities, such as radiology, physiotherapy and occupational therapy * * * and we recommend that the American Medical Association recognize the science of radiology as an integral part of medicine and surgery'."

The purpose of the meeting is clearly stated. We are asking for recognition. We are certainly worthy of it, and what I have written I hope you will interpret in the spirit of constructive criticism coming from one who takes the position that prophylactic measures, instituted to prevent the canker of those ills mentioned above from infesting our profession are timely. We can not totally eradicate these evils, but we can keep them at a minimum by each of us holding strictly to the practice of service before self.

W. A. RUSH, M.D., *Beatrice, Neb.*

Utah Society

A MEETING of the Utah Society of Radiology and Physiotherapy was held in Salt Lake City, September 18th, under the presidency of Dr. Mark Brown. The next meeting, to be held in six months, will take place in Ogden.

CASE REPORTS

Electro-Thermic Coagulation

A. F. TYLER, M. D.
Omaha

THIS PATIENT is a man who at the time I first saw him was 48 years of age. Following the Omaha tornado of 1913, in helping to clear away the wreckage, he bruised his hand near the cardinal's snuff box. Shortly thereafter he noticed a lump in that place and consulted an old-time friend of his—a surgeon. The surgeon made a diagnosis of sarcoma. He was referred to me for x-ray examination, which showed that the sarcoma sprang from the periosteum covering the trapezium. After we had discovered it arose from the bone, the surgeon wanted to amputate the forearm, but the patient refused. He was referred back to me for treatment.

We anesthetized the patient with ether, and used electrothermic coagulation, coagulating the tumor itself and destroying some of the tendons and the bone as well as the other tissues. This is an unusual condition and an unusual method of treatment, but the results which we obtained justified the adoption of this unusual method, because the patient is living and well nine and one-half years after the treatment was given.

This is the only case, so far as I know, in medical literature where periosteal sarcoma has been entirely eradicated without operation. I would like to have him show his hand to you. It is deformed, of course, because the tendons were destroyed. He has good use of two of the fingers and can use the others enough to enable him to carry on his occupation. Following the treatment with the electrothermic coagulation, he had x-ray treatment as well.

Photo nine and one-half years after treatment of sarcoma arising from trapezium showing scar and deformity resulting from electrothermic coagulation of soft tissues and bone.

Renal Tuberculosis With Calcification

C. H. DeWITT, M. D.
Valparaiso, Indiana

MRS. R. C. S., age 40, was referred to me for an x-ray examination of the spine, following an injury to the back.

The film revealed an interesting pathological condition of the right kidney, showing three calcified areas within the kidney shadow.

The patient had no urinary disturbance, and the urinary examination was negative.

She stated that about fifteen years ago she had kidney trouble for some time and that a diagnosis of renal tuberculosis had been made at that time.

Roentgen ray examination of the chest revealed evidence of healed pulmonary tuberculosis.

We concluded that it was a case of healed renal tuberculosis with calcification.

ABSTRACTS and REVIEWS

A Roentgenological Study of Tuberculosis of Lungs and Intrathoracic Glands in Infancy and Early Childhood. I. Edward Liss, M. D., New York Nursery and Child's Hospital and Cornell University Medical School. Am. J. M. Sc. 166:396-402, September, 1923.

ROUTINE roentgen ray examinations help the pediatrician to cut down the percentage of avoidable error in final diagnosis and are an invaluable help in prognosis. In the diagnosis of tuberculosis and respiratory infections of all kinds the x-ray is invaluable when clinical signs are confusing.

In the infant, reactions are much more intense than in the adult and changes are more massive. There is also a definite predilection of the lymphatic structures to disease. Chronicity is exceptional and the early stages of the disease are difficult of differentiation.

Generally speaking, the changes fall under two heads, glandular and those attacking the parenchyma. Glandular changes may be paratracheal, perihilus or peribronchial, the first named change coming earliest in child life, the last later. One region or several may be affected but eventually an entire chain is affected.

The early glandular changes show in the plate an evenly outlined shadow in the upper mediastinal region, rounded or elongated, dependent upon the degree of congestive reaction and the number of glands involved. Smooth contours and even densities are characteristic. Conflicting shadows may be neoplasms, congenital anomalies or the thymus.

The second stage in glandular tuberculosis shows changes due to necrosis and fibrosis. Outlines are irregular, blotchy, with so-called mottling, and there may be a zone of parenchymal congestion. If all this shows, a diagnosis of tuberculosis is a likely one. Retraction of the shadow may take place with an increase in density and accentuation in the mottling or a definite progression to parenchymal involvement may occur.

Parenchymal changes may be pleural or pulmonary. Pleural changes may be either (1) an intralobar effusion or (2) a complication of a diffuse pulmonary involvement. In the first type the process is sharply defined usually between the upper and middle lobes and usually subsides leaving a definite linear scar, but not all such scars are tuberculous. In the second type the changes may be serous or fibrous, serous in small quantities, fibrous in fine filament-like bands or, rarely, a diffuse plastic mass, not unlike adult pleuritis, shows. All combinations of types are present and the authors have never noted a primary uncomplicated tuberculous serous or fibrinous pleurisy.

Pulmonary changes are of three types (1) bronchitic, (2) bronchopneumonic, (3) and lobar. The first is but a stage in a general miliary infection, tubercle barely discernible, death intervenes before full growth of tubercle Markings are accentuated and somewhat congested in appearance. This change is also seen with general miliary abscesses, due to terminal sepsis. If disease is prolonged the process merges into the secondary bronchopneumonic type which may be a bronchopneumonia from the beginning; if lobular in type the disease may be confined to one lobe or there may be extensive involvement with no area larger than one-half centimeter. In diffuse involvement the lung may be so riddled that only a few normal areas can be seen and every conceivable change may be manifested—minute effusions, fine fibrous bands, localized areas of thickened pleura, cavities, etc. The lobar or massive tuberculosis is the rarest type. Two instances of annular shadow have been found present in infancy. For exact visualization of the changes repeated roentgenographic investigation is very necessary.

Radiologic Gastro-Intestinal Studies in Epilepesy. Ward W. Harryman, M. D., and Samuel W. Donaldson, M. D., Uni. Michigan Med. School. Jour. A. M. A. 81:813-815 Sept. 8, 1923.

A review of the literature upon the subject would lead to belief that a colonic stasis exists in constipation associated with epilepsy. In the author's experience roentgen examinations proved that instead of a colonic stasis a hypermotility of the large bowel was present in more than 50 per cent of cases and that the others had normal motility. His conclusions read thus: "(1) No definite evidence of colonic stasis is found by roentgenray examination of the gastro-intestinal tract of epileptics. (2) The term 'constipation' is a complaint of the patient and associated with a cathartic habit. It does not indicate colonic stasis. (3) There are no indications for surgical procedure to relieve these patients of colonic stasis, since a true colonic stasis does not exist."

Roentgen Treatment of Primary Polyglobulia. Frode Rydgaard, M. D., Acta Radiologica, 2: No. 7, 242-260 June 1923.

THREE case reports are submitted. One was cured of polyglobulia by x-ray radiation of the spleen and the others by x-ray radiation of spleen and bone marrow. The former method alone usually produces no effect upon the disease but vigorous x-ray radiation of the bones seems to be an effective remedy. Only the long tubular bones should be irradiated as it is here that hyperplasia is found, and they are usually also the seat of a great deal of pain with this disease and irradiation affords relief. If the spleen is enlarged it is irradiated but otherwise it is not.

The aggregate dosage must be fairly large. Caution is called for in the single series treatment else a sharp decrease in erythrocytes may bring about extreme exhaustion—and it must be remembered that the fall in the number of red corpuscles may not occur until some weeks after treatment.

Series treatments of 10 single doses of 2 to 3 "Sabouraud" are given on one area and after each series the patient must be observed for a month when, if the red count does not fall below five million, a new series is given. As soon as it does fall below five million treatment is postponed for a time. Two to four series are usually sufficient. The dosing of the spleen is a disputed question. The author states that "it perhaps is permitted to conclude that the dosage for the spleen should be between 8 and 16 Sabouraud."

Dermatitis Artifacta Simulating Roentgen Dermatitis. George M. Mackee, M. D., and George C. Andrewes, M. D., College of Physicians and Surgeons, New York City, Am. J. Roentgenol. 10:617-622, September, 1923.

THE introductory paragraph is an abstract of the article. It reads thus: "In this article attention is called to the fact that self-inflicted injuries, lesions and eruptions, that

may be classified under the general heading of dermatitis artifacta (malingering, dermatitis factitia, feigned eruptions, neurotic excoriations etc.) may spontaneously or accidentally simulate roentgen or radium dermatitis; also that malingerers may intentionally and more or less successfully imitate a roentgen or radium dermatitis. In the latter instance the object is revenge, to avoid work, to collect insurance, to excite sympathy, interest, fear, etc. The fact that self-inflicted eruptions may simulate roentgen or radium dermatitis to a degree that will deceive the inexperienced or the unwary, is of scientific interest and of medicolegal importance."

Several case reports are submitted.

What Causes the Healing Action of Roentgen Rays? Summary of a paper by G. Holzknecht, M. D. Read in April, 1923 before the German Roentgen Society. Arch. Radiol. & Electroth. 28:85-89, August, 1923.

FREUND of Vienna believed that roentgen effects were caused by electrical discharges outside the tube. Had this been true radiotherapy would have ceased to exist. "If the assumption is wrong, that ray treatment frequently causes functional increase, then we are in a *cul de sac* * * * it occurred quite recently in the case of the unit dose for carcinoma and sarcoma."

The physicist has devoted endless energy to measurement of dosage and to the effort to secure equal distribution of dosage and of this Dr. Holzknecht says, "The tenacity with which these investigations have continued must be admired, but at times one feels that it is an overestimated idea." In medicine he reminds us, it is customary to use a quantity of medication suitable to the individual case under treatment, the best dose being the one having the least damaging effect and the greatest modifying result — but not so with x-rays. He questions the correctness of this and asks if there is such a thing as a stimulative dose.

He attacks the Arndt-Schulz laws, "dating as they do from pre-chemistry days", and says that the dicta thus laid down (small quantities of every agent stimulate, medium quantities retard, large quantities destroy) are not accepted by pharmacologists nor by biologists — for example, the action of curare and cocaine cannot be reconciled to this law. Many agents are harmful in any quantity. As to what category x-rays should be placed in is a question as yet unsolved and only approachable on the grounds of probability.

"The records of radiology for the first fifteen years mention only the retarding and damaging effects of x-rays, and these were the years when only small intensities were employed. The doctrine of stimulation only came into existence with the era of large doses. If there really exists a stimulative dose for carcinoma, then right up to 1915 we have been stimulating malignant growths; an obvious contradiction. Even today there are no cases reported which are not open to doubt, and those who describe them do not venture beyond opinions, because in their statistic tables the column for 'stimulated' and 'aggravated' is absent.

In Explanation of the Action of X-Rays Is It Necessary to Assume Functional and Growth Stimulation? Summary of a paper by Fritz Pordes, M. D., read before the German Roentgen Society, April, 1923. Arch. Radiol. & Electroth. 89-93, August, 1923.

DR Pordes says that the Arndt-Schulze law may hold for x-rays but he doubts it for the reason that "It is well known that the cells of the human organism are dependent on the action of several agents to which the cells are accustomed, and their effect produces stimulation, as for instance light, heat, oxygen, carbonic acid, potassium, calcium, etc.; these act on the whole nature of the organ, and among them must be sought those which act directly on the cells and seem natural to them, and under certain circumstances act as stimulants, but even these when applied indiscriminately can become harmful and even lethal, not only to the cells but to the organism. Therefore, agents which are not natural to the cells, or inadequate agents, cannot with probability be regarded as stimulants." X-rays are in a higher measure unnatural to the cells, and they exert an effect to which these cannot be physiologically accustomed.

Furthermore: "If we irradiate eggs the incubation period is shortened and the chickens are hatched soon, but there occurs something noteworthy. Highly bred chickens, such as game fowls, lose the particularities of their strain and cast back to the commonest of types. Should these fowls be considered as physiologically improved?" Weber irradiated lilac buds which came quickly to maturity but developed an early necrosis and perished. Teaching data are too often gathered from doubtful results. Information must be obtained from fully developed organisms.

The assumption of stimulation will not do as a working hypothesis. He says: " * * * in order to explain this x-ray effect, without the stimulation hypothesis, the following point must be elucidated: What is the type of cell comprised in a radiated area which possesses the highest sensitiveness to radiation and which in consequence would be the most prone to injury? Then it is necessary to ascertain the diminution or elimination of that particular type of cell, and whether its disappearance always produces the same effect. If we can do so, then x-rays may be regarded as a uniform mechanism, our difficulties become lightened and chaos ended. * * * Let us for a moment enquire which type of cell in an inflammatory field exhibits the greatest degree of sensitiveness. We know now that it is undoubtedly the white blood corpuscles, that the leukocyte infiltration produces the highest degree of sensitiveness, and consequently is the first to be destroyed. It may be urged that the x-ray effect will only harm and not heal, because the leukocytes and phagocytes rally to the defense of the organism in a remarkable manner." Here, Lubasch is quoted to the effect that reparative infiltrations are often produced in such an abundance that they act oppressively on the cells of the organism. Furthermore the writer says:

"Is it not natural and probable that a series of certain x-ray effects, unsatisfactorily explained hitherto, may be attributed to a reduction of the pressure brought about by a decrease of the leukocytes due to x-rays, such as, for instance in phlegmon, erysipelas, parametritis, glandular tumor, chilblains, etc.? The removal of nephritic anuria * * * is also capable of the same explanation. The leukocytic infiltration of acute nephritis increases the pressure inside the kidney capsule, which pressure disappears with x-ray treatment and the function of the organ is restored, apparently just as well as with surgical decapsuling of the kidney. Hence the theory of the resumption of function on the part of the epithelium of the kidney is extremely improbable. * * * The reduction in the number of leukocytes in tuberculosis permits the free infiltration of the auto-tuberculin, producing, as Iselin states, an active auto-immunization, and in this manner many effects resulting from x-ray therapy of pulmonary tuberculosis may be explained." Further on he suggests that "the accelerated passage of blood in a radiated spleen is a much simpler explanation than that of stimulation of the function of the spleen" for the effects produced and amenor-

rhea resulting from small x-ray doses are probably due to the reduction of pressure and not to stimulation though it might be due to an outflowing of hormones, through the destruction of the more mature follicles.

If cells of mature organisms are examined after radiation, not rapidly growing organisms such as eggs and buds, it will be found that the common belief that the nucleus is the most sensitive to radiation will be disproved.

In the concluding paragraph he says: " * * * all the x-ray effects are comprehensive if we keep in mind the different degrees of sensitiveness of the cells lying in the radiated zone; and if we investigate the result arising from the elimination of these particular cells and note the biological effects on the organ, we shall arrive at the conclusion that all x-ray reaction may be regarded as one uniform mechanism, which consistently delays real growth, and is quite irreconcilable with the hypothesis of stimulation."

Results of Skin Tests Made to Determine an Objective Dose for Radium Radiations. Archie L. Dean, Jr., M. D., Memorial Hospital, New York City. Am. J. Roentgenol. 10:654-661, September, 1923.

An empirical method was employed using the skin as a biological indicator with radiation sufficient to cause a faint erythema. The method eliminated the usual subjective errors, thereby the effect of filtration on radium radiation was determined. Quoting from the conclusions to the paper the authors say: "The results show in what proportion the millicurie-hour doses must be varied to produce the standard erythema with brass filters varying from zero to two millimeters. The millicurie-hour doses of Table I are for a distance of two centimeters. For any other distance they will be different but they will maintain the same relative values. Having used skin erythema as a biological indicator, the results are directly applicable to skin dosage in radium therapy. The determinations were made empirically, since no other method is available at the present time. The results, therefore, are not dependent upon any assumed correspondence between physical measurements and biological effects "In attempting to formulate a skin test the result of which would enable us to treat the patients more accurately, we found that the secondary reaction to gamma radiation, when the erythema dose was applied, was closely associated with the subsequent therapeutic result. This finding was borne out in over 200 cases and for many variations of tumor.

"Among those patients who reacted with a skin erythema to the test application of radium and received radium therapy, examination of the records at least six months afterwards showed six benefited to one unimproved. Likewise, considering the class of negative skin tests, or those patients who failed to respond to the test application by the formation of a visible gamma secondary reaction, the number of those not benefited by radium therapy was greater than those who were improved in the proportion of eleven to one.

"It was found that the reactions to the radium skin tests were intimately associated with the quality of the blood of the patients tested. Those with normal or nearly normal blood reacted readily to the skin erythema dosage, while anemic individuals either failed to respond entirely, or reacted faintly and atypically. The association between the positive skin test and favorable blood findings has been so close throughout these experiments that we believe the latter factor to be of the greatest prognostic value. On the basis of our results the patients with a normal or nearly normal blood picture, other factors being equal, will be benefited or cured by radium therapy, while the anemic individuals will fail to show such a favorable response to the same treatment. We therefore recommend the routine blood examination of each cancer patient, both before radium treatment and during the course of observation, with the idea of maintaining a high hemoglobin content and red blood cell count, so that the most favorable reactions possible may result from our radiation therapy."

The X-Ray Department. John B. Zingrone, Director X-Ray Laboratory, Mercy Hospital, Chicago. Hospital Progress, 4:341-344, September, 1923.

A thorough and reliable x-ray technician should have a knowledge of elementary electricity, knowledge of how to operate the machines and to prevent injury to self and patient and damage to apparatus, knowledge of photography and chemistry sufficient for perfect results in dark room work. The technician should know the osteology and anatomy of all organs demonstrable by the x-ray. At least high school education is preferable.

Plans for the laboratory should not be left to the architect or building committee. The roentgenologist has a knowledge of his needs that they do not have. No one plan will be satisfactory under all conditions but the size of the hospital, nature of the work to be done and funds available must all be considered in the plan. The writer does not agree that the x-ray room should be next the operating room. Arrival and departure of patients and noise of apparatus in a busy x-ray department is not a desirable environment for the operating force next door, to say nothing of the dust carried by the air currents through communicating passages. "If the routine is established that all radiograms be examined by the surgeons in consultation with the roentgenologist very few of the radiograms will be required in the operating room." The x-ray department in the Mercy Hospital of Chicago is located on the ground floor close to the emergency entrance and within fifty feet of both freight and passenger elevators.

A model x-ray department consists of a reception room, large and well ventilated, executive offices for stenographer and file clerk, diagnostic room for interpretation of radiograms with complete illuminating and stereoscopic apparatus, fluoroscopic room with vertical and horizontal outfits and x-ray machine for general radiography together with a lavatory. It should have a general radiographic room equipped with latest type x-ray machine, radiographic table, Bucky diaphragm attachment and three Coolidge tubes (fine, medium, broad focus), lead lined boxes for films, a stereoscopic outfit for either vertical or horizontal stereoradiography, lead numerals and letters for marking films. It should have a therapeutic room with a high tension transformer, four x-ray tubes of latest model, wooden table, tube stand, lead glass casing around tube, and leaded rubber sheeting for patient's protection. Walls, ceilings, and floors of every room should be lead lined for at least one-eighth inch, and the treatment room must be so lined.

The department should have a machine room to contain the machines for both rooms—this avoids noise and protects the operator, at least a booth for the operator with a leaded glass window should be provided if the machine room is absolutely out of the question.

The dark room should have a ventilating system and all the necessary apparatus for the work to be done there. A storeroom for the chemicals, films, and portable machine should be provided, at a distance of 75 to 100 feet from the field of operation to avoid fogging of films, etc. Dressing rooms and lavatories enough for the patients, and a preparation room for preparing emulsions, storing linens etc. are necessary.

Patients are apt to be nervous upon a first visit and they should be told that the procedure is painless and is very necessary for diagnosis. The machines should be tested before the patient enters the room and the technician should be kindly and considerate in moving the patient to proper position, etc. No dressings or casts should be removed by the technician without first an order from the attending physician and no radiograms shown to another physician or a patient without the order of the attending physician. In the author's laboratory operating gowns with ties, no buttons, are used for men patients and plain nightgowns for women. Patients appreciate this protection.

The technician is not an interpreter. The author after 14 years feels that he has much to learn about interpretation.

Working hours for the personnel should not be more than seven daily, with Sunday and another half-day holiday which should be spent outdoors as much as possible. Two weeks' vacation is the minimum. In hospitals those working in the x-ray department as technicians or nurses should have no additional hospital duties. Ventilation should be by suction outfit and electric fans besides an air-cooling system.

Tubes for screen examinations should be inclosed in protective material equivalent to 2 mm. lead and the fluorescent screen should be fitted with lead glass.

The author conducts his laboratory at a ten per cent profit above all expenses. A complete price list is given in the original paper. During 1922 his department made 3,201 examinations.

The Role of Deep X-Ray Therapy in the Fight Against Cancer. Nathan B. Newcomer, B. S., M. D., Denver. Read at the Annual Meeting of the Wyoming State Medical and Dental Societies, Laramie, June 20, 1923.

CANCER treatment, says the writer, has remained the same from centuries before the Christian era up to the discovery of x-rays and radium.

The American Society for the Control of Cancer estimates the number of cancer patients in the United States at any one time to be 300,000. Statistics are quoted from many prominent cancer workers and the author's conclusion is that, while x-rays and radium are curing from 15 to 30 per cent of inoperable cases, the surgeons are largely blind to the facts.

The author's technique is described in the paper and a very interesting part of this section deals with the differences in technique necessitated by high altitudes. He says: "We measure the voltage that a machine will produce by the distance a spark will jump at sea level under standard conditions of atmospheric pressure, temperature and humidity. At the altitude of Denver there is often a difference of 46 per cent in the distance a spark will jump between points. The manufacturers make most of their machines at sea level and do not realize how much they must separate the different parts of the machine to prevent sparking between parts, and they seem to think that you do not know what you are talking about when you tell them of your difficulty. I have seen 60,000 volts as measured on the primary voltmeter jump nine and one-half inches between parts of the machine and between points of wire. We have tested two 85,000 volt machines which should deliver seven and one-half inch gap, and they would spark between parts of the machine at four and three-fourths inches at the altitude of Denver. So the maximum output of these machines would be less than 60,000 volts at the altitude of Denver." The fact that a man has all the equipment possible does not argue that he knows how to use it and harm is being done by those who do not understand the principles of treatment.

The author's conclusions are: "First, * * * surgery and radium can cure a small percentage of cancer only, and then only when the condition is limited to the primary focus, and their pitiful percentage of cures shows in what a small percentage of cases it is so limited.

"Secondly let us remember that no case of cancer has been properly treated without thorough irradiation by modern deep therapy methods, with a machine capable of delivering at least 200,000 volts to the tube terminals with heavy filtration and administered by a man trained in the physics of deep therapy.

"Finally, let us remember that many cases of inoperable cancer, apparently hopeless (if not actually cachetic), attain a clinical cure by proper deep therapy treatment as administered above."

Observations on X-Ray Cancer. J. Henry Dible, M. B., M. R. C. P. and J. M. Woodburn Morison, M. B., C. M., University of Manchester. Arch. Radiol. & Electroth. 28:65-72, August, 1923.

IT has often been held that the essential in producing experimental cancer is the presence of a specific substance stimulating the growth of epithelial tissues; but x-ray cancer stands alone in that it is caused by a purely physical agency, for if growth promoting substances are present they certainly are not connected with the prime irritant.

A case of x-ray cancer is reported in a radiologist in the Oldham Infirmary. He has been exposed to the rays for twenty years and at first did not use protective devices. About 1911 he began to notice a burning irritated sensation in his hands, particularly at night, but there was no real pain. Soon after this the skin and tissues of his hands became noticeably shriveled and discharging warts appeared upon the backs of his hands. The ulcerated areas extended and refused to heal in spite of numerous forms of treatment and one of them was of such nature as to be suspected of malignancy. Amputation of the first, second and third fingers of the right hand was done, and histological examination of this particular growth proved it to be a typical squamous-cell carcinoma differing in no essential from tumors of this type occurring in the skin. Sections of isolated warts showed only simple keratoses.

About twenty months later examination showed no recurrence, healing of the surface was complete, a few warts present on the remaining fingers of the right hand. The left hand showed a few small, hard, scattered warts with no ulceration. These were gradually growing smaller.

A review of the literature shows that in one class of x-ray carcinoma the disease spreads rapidly when once under way—in the other type lesions are very callous and remain local.

Recent Developments in Protective Methods and Appliances as Used in Radium Therapy. Curtis F. Burnam, M.D. and Grant E. Ward, M. D., Baltimore. Am. J. Roentgenol. 10:625-632, September, 1922.

THIS artical is supplementary to the one by Dr. Howard A. Kelly on "The Care of Radium in the Hospital" which appeared in the May 1922 issue of the *Modern Hospital* and was abstracted in the July 1922 *Journal of Radiology*, page 300.

The essentials necessary for protection are claimed to be met in certain apparatus described in this paper (tables, cylinders, emanation carriers and suspension apparatus). The illustrations and detailed descriptions of these must be seen in the original paper to be of value.

The essentials of efficient apparatus are given as: 1. Prevention of radiation of patient except at site of disease. 2. Cross-firing without overlapping. 3. Absolute immobility. 4. Easy and accurate manipulation. 5.

Comfort. 6. Protection of nurse.

The authors favor the use of aluminum and rubber filters to absorb soft secondary radiation when using lead protection (in treating cavities the gauze used in wrapping the lead filters absorbs the soft secondary rays from the lead).

The treatment tables described facilitate heavy external treatments and all treatments which require a change of posiion from the perineal to the dorsal, and at the same time an added protection is given those who are in the rooms below the treatment room.

The Removal of Tonsils. With Special Reference to Methods Other Than Complete Enucleation. Burt Russell Shurly, M. D., Jour. A.M. A. 81:800-802, Sept. 8, 1923.

THE author does not regard with favor the use of the x-ray in diseased tonsils, his experience being very unsatisfactory. He does recommend that it be tried in bad operative risks, that is, in the "bleeders", in advanced pulmonary tuberculosis, cardiac disease, nephritis, diabetes, borderline cases and for the neurotic, the senile, the fearful and the hysterical patient.

The Resistance of the Thyroid Gland to the Action of Radium Rays. The Results of Experimental Implantation of Radium Needles in the Thyroid of Dogs. J. O. Bower, M.D., F.A.C.S., and J. H. Clark, M.D., Department Surgical Research, Uni. Pennsylvania. Am. J. Roentgenol. 10:632-643, September, 1923.

THE experimental work here reported was undertaken to determine the effect of radium rays on normal thyroid tissue. The results seem to indicate that the type of tissue irradiated is of equal importance with dosage used. Conclusions from the study are:

1. "The primary changes induced by radium in the thyroid are hemorrhage and necrosis. Organization and healing are evident the third week and complete about the twelfth.

2. "The normal thyroid gland is distinctly resistant to the action of radium; it is not a good tissue for the study of the finer histologic changes produced by radium; the nuclear degenerative changes characteristic of radiated malignant tissue were never seen.

3. "No toxic symptoms of any sort were observed.

4. "No changes were demonstrable in the parathyroids.

5. "The apparent resistance of the thyroid tissue to radiation wo ld make it appear that implantation would be superior to surface applications, and that relatively large dosage must be employed to assume any extensive effect upon the gland."

Elevation of the Diaphragm. Unilateral Phrenic Paralysis. A Radiological Study with Special Reference to the Differential Diagnosis. J. M. Woodburn Morison, M.B., C.M., Royal Infirmary, Manchester. Arch. Radiol. & Electroth. 72: 353-364, May, 1923 and 28:72-83, August, 1923.

EVENTRATION of the diaphragm and unilateral paralysis are indistinguishable both clinically and radiologically except that a definite pathological lesion involving the phrenic nerve in its course through the thorax can be demonstrated in cases of unilateral phrenic paralysis.

The term "eventratic diaphragmatica" should be applied to "those cases of congenital origin in which there is a diffuse relaxation of one-half of the diaphragm, so that it extends high up into the thorax, forming a sac which contains a portion of the stomach and sometimes a part of the colon and mesentery. All the cases recorded have been on the left side with the exception of one by Eppinger in 1911."

The radiological examination makes it possible to interpret the signs found upon physical examination and to render a correct diagnosis. The diaphragm extends high up into the chest, forms a dome inclosing an air space upon the bottom of which lies a free fluid which upon palpation shows waves and ripples. The presence of this horizontal line of fluid depends upon the amount of fluid in the stomach, but the level of the line is always that of the cardiac orifice. The upper boundary of the dome appears as a bow line, unbroken across the left hemithorax and maintained in all positions. It is formed by the thinned out diaphragm. The author differs with those who say that no movements of the bow line occur. They may be very slight. They move upward with inspiration and downward with expiration, if there are no adhesions to the lung.

The air sac of the dome is always present, at times a portion of the colon may be found lying alongside and the different pressure of gas in the colon and the stomach may cause an irregularity of the bow line. Lung tissue can usually be seen through the air space of the dome, but whether it is seen probably depends upon the development of the left lung. There is a real difference in the expansion of the right and left chest. Part of the heart shadow is also usually seen but displacement to the right is not a marked feature and when it apparently exists may be due to rotation. In nearly all cases there is a definite deformity of the stomach, due to the ascent of the greater curvature under the elevated diaphragm, with rotation on more or less fixed points which may be great enough to cause a volvulus requiring surgical interference.

Unilateral phrenic paralysis is not uncommon and it may be diagnosed definitely by the x-ray. The author has had nine cases within the year, two proved at postmortem. The right phrenic nerve was involved in two, the left in seven. Three cases occurred in secondary carcinoma of the mediastinum, secondary in one case to that of the stomach, in the other two to that of the breast. Three others were associated with pulmonary tuberculosis, two with a growth in the chest and one with aneurysm of the aorta.

Disease or injury may affect either the right or left phrenic nerve and cause paralysis of the corresponding leaflet of the diaphragm. In left phrenic paralysis the radiological signs are the same as for eventration. "It is only a question of variation in degree and of complications due to the presence of active disease." (Series to be continued in future numbers of Archives of Radiology and Electrotherapy.)

Complete Anterior Dislocation of the Distal Epiphysis of the Femur. Theodore West, M.D., Am. J. Roentgenol. 10:519-521, July 1923.

WITHOUT an x-ray examination this injury may be mistaken for a simple fracture of the lower end of the femur. It is important that the true condition be known else compression of the popliteal vessels may result in gangrene. Also it is important with these lesions that prognosis be guarded since any injury to an epiphyseal line may destroy the center of growth and the bone will then become shorter than its mate.

The lesion may occur at any time before the age of 23 or 24, the age at which ossification of the femur is complete. The greater number of cases occur between the ages of 10 and 20 years, the most active years, and may be the result of a fall or of traction in setting or treating a hip. Any disease which affects the growth or development of the bones is of course a predisposing factor.

A typical case is reported.

Observations on Ostitis Deformans. Sherman Moore, M.D., Am. J Roentgenol. 10: 507-518, July 1923.

THE literature is reviewed and four unusual cases occurring in the author's practice are reported.

The literature records 246 cases, exclusive of 14 in the author's practice. The facts scarcely warrant the commonly accepted belief that the disease is very rare. "The probabilities are that if sufficient x-ray search were made, the disease would be more frequently discovered."

When a case is fully developed, diagnosis can be made at a glance but senile and arthritic changes of the skeleton closely resemble the deformity of ostitis deformans. Limited to a single bone it much resembles syphilis but syphilitic tests plus antiluetic treatment will differentiate the condition. Differentiation must be made between syphilis, tumor, chronic inflammatory states, true hypertrophic changes, ostitis fibrosa cystica, osteomalacia and (restricted to the skull) hyperostosis cranii and leontiasis ossium.

Radiographic findings in order of their importance are: changes in texture, size, form and outline of bone. Deformity is largely the result of bony creased bulk arising neither from an internal expanding process nor as an enlargement. Most significant is in-apposition or accretion. In the cortex of the long bone there is early a rarefied condition. Instead of a homogeneous smooth-textured, compact layer there is a wide-meshed, coarsely reticulated structure in whose interstices is a softer tissue relatively deficient in calcium. Later on there appear irregular, patchy, dense bone condensations. Rarefaction and condensation go on side by side, the former is primary, the latter is reparative. Alterations of form are a late manifestation and a distinctive finding. Pagetic bone is smooth in outline and its curvature is even. However, radiographic findings in this disease are very difficult of verbal description and the findings vary with the state of development.

"From the standpoint of treatment it is useless to study Paget's disease at present. It should, however, be carefully investigated, for the reason that there might be uncovered a function of bone other than the rather passive ones of support and the housing of blood-forming organs It is conceivable that aberrance of this possible function may produce the disease known as ostitis deformans."

Roentgen Ray Study of Non-Luetic Periosteal Bone Lesions. Roy G. Giles, M.D., Am. J. Roentgenol. 10:593-599, August, 1923.

THE periosteum casts a shadow only when calcium salts have been deposited in it. Periosteal bone production is the result of a reaction to some irritant acting as a stimulus.

Non-luetic periostitis and the new subperiosteal bone may be seen in fractures or in trauma without fracture, osteomyelitis, tuberculosis, typhoid, leprosy, pulmonary osteoarthropathy, ostitis deformans, rickets, scurvy and in proliferative bone tumors.

The points in diagnosis are discussed for each of these, in too great detail to abstract.

The Correlation of the Radiographic Bone Pathology of the Jaws with the Incidence of Secondary Infections. John S. R. Heath, L.D.S., R.C.S., (England). Dental Cosmos, 65:937-940, September, 1923.

FOR an oral radiogram to be of full value the case history and all other potential forms of infection must be fully considered. Diagnosis is too often limited to a study of the state of the periapical tissues and the amount of destruction of interdental bony septa, with no attention to the effects of infection upon the fine osseous network of the alveolar processes and adjacent jaw bone. The pathological changes in these structures are of course dependent upon the virulence of the invading organism and the resistance of the individual. Moreover it takes a trained interpreter with a good knowledge of pathology to interpret the changes wrought by chronic infection. The true state of the finer structures calls for study by transmitted light in a dark room, aided by the magnifying glass. Most dental radiograms are overexposed, or taken with too hard a tube, and are of value only for the study of gross changes.

This article is written only for those who "know the microscopical and macroscopical morbid anatomy of bone" as a reaction to a chronic infection, and it is inferred that no others should consider themselves competent to pass upon dental radiograms. The reaction from an oral infection is not so different than the reaction from the same infection would be in any other part of the system. "As * * * x-rays show us only relative translucencies we must interpret from these the effects of * infections on the jaw bones, and learn by testing clinically the result of removing these infections to correlate our pathology of the jaws with the etiology of secondary infections."

Dr. Stanley Colyer of London is thus quoted as to the three chief types of pathology which may be found by detailed study of the film with a magnifying glass:

(a) Wooliness or fleeciness of bone, due to thickening of trabeculae and decreased translucency of cancellous spaces.

(b) Patches of either increased or decreased translucency. First type is irregular, due to rarefaction but may have sclerosed area surrounding. Second type (decreased) due to sclerosis, may be sclerosed trabeculae or "healed small dark spots."

(c) Small dark spots surrounded by sclerosed bone are strong evidence of an active or residual infection liquefying the cancellous areas—density of surrounding sclerosed ring indicates resistance offered the bacteria. The evidence of their infectivity is (1) clusters of these around infected teeth (2) occurring in interdental bony septa when there is a marginal ostitis (3) and appearing close up against exostosed roots.

These must not be confused with canals of nutrient vessels which have a similar appearance. Colyer believes that treatment will probably be succesful when the sclerosis in large or small masses exists without the presence of rarefied areas or clusters of small dark spots. The author of this paper however does not believe that Colyer has made this clear and in further elucidation he himself says:

"The 'small dark spots' would indicate, I think, colonies of bacteria of such a virulence as could live in the cancellous spaces at some little distance from the area of primary infection in spite of nature's attempts to remove them, showing the possibility, at least, of their being able to settle down and live still farther afield. In the cases I have dealt with showing 'small dark spots' there has consistently followed a fairly acute systemic reaction with an increase of the secondary symptoms. This has occurred so consistently as to establish to me these 'small dark spots' as of first-class diagnostic importance. When the spots have around them white circles of sclerosis, or attempts at sclerosis show elsewhere in the radiogram, I have found that the alleviation of the symptoms has been in fairly direct proportion to the density of the sclerosed areas."

Dr. Colyer's findings, Dr. Heath believes are based on sound evidence.

The Roentgenographic Study of the Mucosa in Normal and Pathological States. Richard A. Rendich, M.D., Bellevue Hospital. Am. J. Roentgenol. 10: 526-637, July 1923.

THE condition of the gastric mucosa has been studied chiefly through consideration of the rugae. The principal object of the study was to demonstrate the rugae as indicative of

gastritis.

The author has found that pathological changes of the hollow viscera are roentgenologically revealed before any deformity of visceral outline is produced. The condition of the mucosa is a very important pathological feature and radiographic demonstration of its abnormalities appears so characteristic that it can be made very useful in diagnosis.

A fifty per cent mucilage of acacia with an equal volume of bismuth subcarbonate is used with the patient partially recumbent on the fluoroscopic table. The patient is not allowed to raise himself and palpation is not desirable. Exposures are made directly after placing the screened film in position.

The method has served the author satisfactorily in: (1) more detailed and confirmative examination of gastric ulcer; (2) more complete study of gastric neoplasm; (3) differentiation of extra gastric pressure defect from intrinsic gastric lesions; (4) more satisfactory examination of the enterostomized stomach; (5) the study of gastritis; (6) the demonstration of the small intestine; (7) detection of mucous erosion; (8) further differentiation of benign and malignant ulceration; (9) differentiation of spasm from organic lesion and differentiation of duodenal and periduodenal adhesions.

Secondary Signs of Gall-Bladder Pathology. Ralph D. Leonard, M.D., Am. J. Roentgenol. 10: 521-526, July 1923.

DR. LEONARD states that he has felt somewhat disturbed over the fact that certain leaders in the medical world have expressed grave doubts of the value of x-ray diagnosis of gall-bladder pathology. He put some searching questions to himself and came to the conclusion that the difference of opinion was more apparent than real. At times roentgenologists have based their conclusions on weak premises and have been overenthusiastic in their claims, at times technique and interpretation have been at fault, but between the two extremes of the skeptical and the over optimistic is "a safe and sane ground where honest and careful roentgenologists may successfully employ the x-ray in the study of gall-bladder disease, both with satisfaction to their consultants and profit to their patients."

First of all, gall-bladder statistics are, necessarily, usually derived from incomplete premises; statistics thus derived are of course useless or even vicious. Operative cases form a very small per cent of all those coming for diagnosis, and gall-bladder diagnoses can be checked up only at operation. If operation is necessary the case is so advanced that there scarcely can be error in diagnosis of gall-bladder pathology. The careful and persistent pathologist can find at least a slight pathology in every adult gall-bladder over the age of 23. (In the discussion of this paper Dr. Cole stated that if the pathologist's salary depended upon the hospital he most certainly would find this pathology in every gall-bladder surgically removed and sent to him.)

A "negative" opinion arrived at in a routine examination, or in examination for ulcer or appendicitis, is often confirmed but practically speaking it is misleading if regarded as giving a true evaluation of x-ray diagnosis.

Again, the roengenologist can very easily be influenced by his knowledge as a clinician. In this way the x-ray is often given credit which does not belong to it.

Lack of success in diagnosis often rests upon the worker's lack of appreciation of the relative value of the different classes of x-ray evidence of gall-bladder disease. Two-thirds of correst diagnoses are based upon indirect evidence, i. e., demonstration of changes produced in other organs by gall-bladder disease. Less than a third of cases will show definite direct evidence such as gall stones or a visible gall-bladder.

One class of indirect evidence is found in pressure deformities, the duodenum being most frequently affected. The typical curve of the gall-bladder may be seen on the exterior surface or perhaps on the superior surface. Pressure from above will produce a flattening of the cap almost pathognomonic of gall-bladder disease. (Dr. Cole in his discussion remarked that other things in the right hypochondrium might give the same effect and must be kept in mind, e. g., the caudate lobe). The antrum of the stomach, particularly with enlarged gall-bladders, may show characteristic pressure. With considerably enlarged bladders pressure effects may be noted in the hepatic flexure or proximal transverse colon.

Adhesions may account for changes. The stomach and first portion of the duodenum may be abnormally fixed over the right side. The second portion of the duodenum may be displaced in widely varying degrees to the right. Occasionally the hepatic flexure and proximal transverse colon show evidence of fixation due to gall-bladder pathology, the latter may be angulated and displaced upward (pseudo-hepatic flexure). It may also have a tab-like projection pointing upward and inward from its superior surface; this is definitely characteristic of gall-bladder adhesions.

A rather extensive tonic contraction of the pyloric half or third of the stomach persisting throughout several films or in the fluoroscope is a very suspicious sign and the same is true of the ampulla of Vater rendered visible by barium retention.

Very often the indirect evidence consists of such a slight variation from the normal that any but the experienced worker will fail to detect it.

Direct evidence is found only in the minority of cases. Mistakes may occur here from the shadow cast by a food filled antrum of the stomach, which, however, will be an inconstant shadow. An unusually shaped edge of the liver, or a kidney, may cast a confusing shadow. Congenital diverticula may be mistaken for the ampulla of Vater which is not so large but about the size of a pea and is confined to the inner side close to the second portion of the duodenum at about the juncture of the upper and middle thirds. Diverticula may be found anywhere.

"A persistent use of films with intensifying screens and possibly the Bucky diaphragm is essential for any sort of a demonstration of direct gall-bladder evidence. Furthermore a barium meal with practically a complete gastro-intestinal examination is required to bring out adequately the secondary evidence. * * * Again, the patient must appear for examination with the gastro-intestinal tract empty."

Habitual use of the screen with an occasional film will result in failure if employed in gall-bladder diagnosis.

Diagnosis of Obscure Abdominal Lesions by the Roentgen Gastro-Intestinal Examination. W. H. Dickson, M.D., C.M., Toronto General Hospital. Am. J. Roentgenol. 10:540-546, July, 1923.

FOUR pages of descriptive detail and about two of illustrations make up this article. Dr. Pfahler in his discussion of the paper especially thanked Dr. Dickson for the discussion of the many variations of pathology, especially that of the pancreas, and remarked that brilliant diagnoses might be more frequent were more thorough study brought to bear upon the unusual instead of leaving the diagnosis with a question mark after it.

The article deals with the filling defects and deformities of the stomach, duodenum and colon caused by pancreatitis, carcinoma, cyst of the pancreas, retroperitoneal tumor and other extra-intestinal growths. Tumors of the liver, pancreas, spleen, kidneys, gall-bladder and retroperitoneal area exert a pressure, which is usually char-

cteristic, upon the adjacent hollow iscus and the lesion is thereby loated. The article discusses these ndings in detail.

The technique used is the same as or all other gastro-intestinal work in e author's practice, namely, barium-uttermilk meal, fluoroscopic examination with palpation, plates, in the erect, nteroposterior, prone and right oblique ositions. Pneumoperitoneum has been sed but the author has now discarded s use as he believes it contains an ement of danger and his routine ethod yields better results than did e use of pneumoperitoneum.

Two aims are kept in mind: localation of the anatomical situation of e lesions and the establishment of e pathological entity of the condition.

Home Made X-Ray Diagnosis. Charles D. Enfield, M.D., Am. J. Roentgenol. 10:581-583, July, 1923.

THIS editorial is a clear cut exposition of the necessity of roentgen terpretation being done by a specialt in roentgenology and not by a layan, general practitioner, or any other ecialist, unless the case is so simple at there is no danger of error.

Aside from the long training necssary to do this service well, there is nother factor involved, namely, the ct that it is almost humanly impossile to exercise unbiased judgment in entgenological diagnosis if the case as first been studied in any other ay by the one who makes the roenten interpretation. Clinical bias of ourse does not occur where evidence clear cut but it is in the border-line ases where the harm is done—harm hich too often reacts upon the patent's welfare and consequently upon e good name of roentgenology.

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occidioidal Granuloma. Raymond G. Taylor, M.D., Am. J. Roentgenol. 10:551-558, July, 1923.

THE specific fungus which causes this disease usually attacks either e skin or the lungs, though its initial ppearance may be in the joints. In eneral the lesions are classified as inectious granuloma.

The mode of onset, clinical course nd pathological picture are all strikngly like tuberculosis. Eventually e infection becomes general and terinates fatally, although amputation of n affected member has been known to rrest the disease.

The natural habitat of the organism ausing the lesion is not known. It eems from evidence to be native to alifornia, most of the cases coming rom the San Joaquin valley.

Nine case reports with eleven roentgen pictures are given.

Radium Emanation Ampules in the Treatment of Cancer of the Tongue. Frank Edward Simpson, M.D., Illinois M. J. 44:139-142, August 1923.

IN about fifty per cent of primary tongue lesions surgical methods are of no avail and implantation of radium may give relief. In the operable cases results are as good as with surgery and some workers believe they are better.

The cervical glands may become invaded within a few weeks after the tongue lesion first appears or may not become invaded for six months. Death usually comes before distant metastases can occur.

Diagnosis may or may not be easy and usually it rests between cancer, tuberculosis and syphilis. However a primary tuberculous ulcer of the tongue is very rare. Sectioning is definite proof but is regarded as dangerous.

Implantation of radium emanation in ampules has met with such success in the author's practice that after extensive experience with other methods he has discarded them all in favor of implantation.

In ordinary cases, 5 to 20 ampules each containing one-half millicurie of emanation are inserted in the lesion and one treatment as a rule suffices to bring about healing in from 6 to 12 weeks. Details of technique were published in the *Chicago Medical Recorder* of January 1923.

End-Result Study of Dermatological Cases Treated by Roentgen Rays. C. Guy Lane, M.D., Mass. Gen. Hosp. Boston M. & S. J. 189: 174-177, August 2, 1923.

ELEVEN of twelve cases of acne vulgaris of from one to six years' duration were cured with from 4 to 15 treatments.

Ten of 14 cases of eczema showed marked improvement. These ten were of the localized type. Those of the general type did not do so well. In addition to these 14 there were five cases of sharply localized neurodermatitis which responded extremely well.

Ten of 13 cases of sycosis of one to seven years' duration showed marked improvement. Five are well and one other appeared well for one year after which recurrence took place for which treatment gave no relief.

Two cases of psoriasis did not improve. One did improve with a recurrence ten months later which, however, responded to treatment.

Five cases of chronic uticaria yielded distinctly unsatisfactory results, only one case was improved.

Sixteen (localized) of 38 cases of pruritis showed marked improvement but the general type failed to respond.

Two cases of mycosis fungoides are well one and one-half years after treatment while another case responded for only a short time.

Sixty-six cases of ringworm of the scalp were treated with complete success. The whole scalp should be radiated and standardization of apparatus is most important as too little raying will not produce epilation and too much will produce permanent epilation with scarring and telangiectasis. The action of the radiation is mechanical in that it has no effect upon the fungus itself but by removing the hair eliminates the fungi.

Two of five cases of keloid improved.

Five cases of lupus vulgaris failed to improve. The writer believes that only recent cases which show little scarring and have had little treatment previous to radiation are suitable for x-ray treatment.

Five cases of scrofuloderma were healed.

Eleven of 14 cases of epithelioma and keratosis were pronounced well after unfiltered radiation of one and one-half to two erythema doses at intervals of from three to four weeks.

Among 28 miscellaneous cases improvement occurred in several cases of warts, fungus infection of the hand, excessive sweating, certain types of lichen planus and in blastmycosis.

Report of Cases of Malignant Growths of the Bladder Treated by Resection and Radium. Henry G. Bugbee, M.D., J. Urology, 10: 159-171, August, 1923.

DIRECT application of radium by means of the cystoscope has not given satisfactory results in bladder tumors. A case treated by surgery alone is apt to terminate fatally in from one to two years. The question at present is, "How efficient is radium going to prove when used as an aid to surgery?"

The author presents 19 case reports from his own practice, 14 males, 5 females. Age varied from 40 to 90 years, only three being past 70 years of age. Six showed a papillomatous growth, 13 an infiltrating growth and all are classed as malignant although in several cases pathologists disagreed.

Most of these cases received treatment from two to three years ago, only three were reported later than December of 1921.

Ten cases are free from growth, in two the growths are rapidly receding, two were hopeless cases from the start, and the remaining five have a metastasis.

When metastasis has taken place the patient should be made as com-

fortable as is possible. Sometimes simple bladder drainage accomplishes this. A circumscribed carcinoma should be removed by resection if at all possible. Recurrences after operation are less resistant than the primary growth. All cases should be carefully watched for recurrences.

In extensive carcinoma of the bladder without metastasis, in lieu of total or subtotal cystectomy it is possible in some cases to destroy the growth by repeated insertions of radium needles —"if one bears in mind that he is trying to destroy the growth, not the patient"—using not too massive a dose but employing repeated insertions at sufficient intervals and securing free bladder drainage for sloughing and infection. Body elimination must be carefully looked after also.

Sunlight and Disease (Heliotherapy). P. M. Daneel, M.D., Staats, Germany. South African Med. Rec. 21:265-271, June 23, 1923.

DR. ROLLIER'S school in Leysin where the children's naked bodies are constantly exposed to the sun's rays has been duplicated by Dr. Francken at Lake Geneva and the results are said to be most remarkable.

These children "from far and wide with deplorable clinical histories of enlarged glands, adenoids, bronchitis, colds, etc." improve markedly under this treatment. The author states that tuberculous bones and glands seldom need surgical treatment if heliotherapy is first tried. Malta fever is said to be cured by the treatment and likewise intractable anemias, rickets, rheumatism and vague abdominal and chest conditions. Six remarkable case reports are submitted.

The history and scientific theories of the disease are discussed at some length.

Report of a Case of Erysipelas Treated with Reflected Incandescent Light. Frank Thomas Woodbury, M.D., Am. J. Electroth & Radiol. 41:247, August 1923.

A THERMOLITE bulb attached to a "goose-neck" desk-lamp fixture was used in a case of early erysipelas with very satisfactory results which were quite apparent within a few days.

A lamp was applied on each side of the patient's face each aletrnate hour for a week after which the patient was considered to be out of danger but as puffiness and smarting continued treatment was continued for another week. Alcohol compresses were used between irradiations and one-thirtieth grain of strychnine sulphate was given thrice daily.

Adhesions of Tendons Treated by Physiotherapy. Sinclair Tousey, M.D. Am. J. Electroth. & Radiol. 41:247-248, August 1923.

RESTORATION of function to a hand helpless for two years as a result of adhesions of tendons is here reported. The patient, aged 60, had had a Colle's fracture of the right wrist two years before treatment was begun. Motion, either active or passive, was quite impossible.

To remove the fibrous deposits about the tendons radium filtered through 0.4 mm. steel, 1 mm. brass and 16 mm. felt was applied for two hours every other day for three days. No skin reaction whatever resulted from this radiation.

Radium treatment was then followed by diathermy and when some movement was obtained the diathermy was supplemented by the use of the sinusoidal galvano-faradic current of about 5 ma. through both hands for fifteen minutes (daily?). Within three months from the beginning of treatment patient had a grip pressure of 22 pounds and was able to lift a shovelful of coal into the furnace.

To move the fingers and to strengthen the muscles a rythmic static induced current was applied and at the end of seven months from the first measures of treatment patient had a grip pressure of 47 pounds, complete freedom from pain and full motility and use of her hand.

Physiotherapy As An Adjunct to General Medicine. Louis Feldman, M.D., Am. J. Electroth. & Radiol. 41:249-255, August, 1923.

UNDER physiotherapy are included all therapeutic measures which are neither surgical nor medical, such as massage, manipulation, curative exercises, hydrotherapy, heliotherapy, thermotherapy, electrotherapy, mechanotherapy and x-ray, to a certain extent.

The last named is most valuable in physiotherapy in determining indications and contra-indications for treatment and in checking up the progress of treatment.

"There is no place in the field of medicine for the cultist who with narrow vision practices only one unit of therapy without regard for the merit of all others." Every graduate in medicine worthy of his calling will keep an open mind and will investigate the worth of all methods of treatment and give his patients the benefit of the best which the whole field offers his case.

The Treatment of Menorrhagia by Radium. Sir G. Blacker, M.D., F.R.C.P., London, The Lancet, 1:421, March 3, 1923.

DURING the six years ending July 1, 1923 the author has treated 77 patients by intrauterine application of radium emanation or element. Thirty-four were treated for excessive hemorrhage at the menopause; ages were 40 to 52; only one case unsuccessful. Twenty-three were treated for hemorrhage associated with fibromyomata; ages 36 to 55; five cases so far unsuccessful but further treatment is being tried and success is thought likely. Eleven were unaccompanied by any disease and treatment was for excessive hemorrhage alone; ages 22 to 42; three were successfully controlled, in six complete amenorrhea resulted; two resorted to hysterectomy. The other nine cases were lost track of and so not reported.

The author considers this treatment is a valuable and efficient method for the first type of case, that it is a safe method for the second type if uncomplicated, and that it is a valuable means of treatment in the third type of case when other methods have proved useless.

Localization of Brain Tumors by Cerebral Pneumography. Walter Dandy, M.D., Am. J. Roentgenol. 10: 610-616, August, 1923.

DANDY believes that by means of the x-ray it should be possible to locate practically all brain tumors. About 15 per cent can be located from the shadows cast by calcification and from skull effects. In 35 per cent the injection of air into the ventricles aids the x-ray diagnosis.

Symptoms of brain tumor are either of localizing character or else they are those of general pressure, and it is in the latter group that the x-ray is of the greaetst aid.

He says, right in the beginning, that the process of cerebral pneumogarphy is a very dangerous one and should be employed only by those thoroughly skilled in intracranial surgery, then the danger is minimal. Compared to operation by guesswork the danger is small.

The cerebrospinal fluid is withdrawn from a lateral ventricle and air is injected, the needle being inserted through the skull opening into the posterior horn of the ventricle, the fluid aspirated and ejected. Unsterilized air is then forced in in an amount equal to the fluid ejected; by turning the head the proper way the air can be shifted to any part of the head.

Due to the difference in density in certain parts of the chamber, shadows are cast and the changes from the normal in size, shape and position (due to pressure) will render diagnosis possible. However, in one group (bilateral hydrocephalus and in which

two lateral ventricles communicate freely) all that can be ascertained is that there is a lesion between the aqueduct of Sylvius and the foramen of Magendie. Interpretation is neither simple nor "fool"-proof. The leading points in interpretation are briefly sketched.

In the discussion which followed the paper Dr. Kerr said that while in Dr. Dandy's hands the method was safe and of utmost value it might be far otherwise and even misleading in the hands of others less skilled, for instance, in cases of abnormality of the ventricles. He also mentioned that the air should be evacuated without failure as he himself might have averted a fatality had he known this and he has noticed in other cases that removal of the air brings the condition of the patient back to normal.

Dr. Baetjer said that sometimes hours of study were required to interpret the plates, and expressed his great admiration of Dr. Dandy's achievements in cerebral pneumography.

Carcinoma of the Esophagus. Porter P. Vinson, M.D., Mayo Clinic. Am. J. M. Sc. 166:402-414, September, 1923.

THE incidence of this lesion is far more common than is generally thought. The symptoms are characteristic and of about one year's duration. Men are five times more often the victims than are women and in men the lesion is more common in the middle third of the esophagus, in women in the upper third. Demonstrable metastasis is infrequent but is more common in women on account of lesions of the introitus. Trauma is not a factor and the lesion is rare under the age of forty. The x-ray is of value in diagnosis but it is not infallible. Radium and x-ray have not as yet cured any case but do offer palliation in many cases. Surgery is of very little curative or palliative value but mortality in untreated cases is 100 per cent.

Cellular Regeneration under Ultra-Violet Stimulus. A. J. Pacini, M. D. Am. J. Electroth. & Radiol. 41:226-227, July, 1923.

IN treating ulcerated surfaces it must be remembered that actinic tolerance is dependent upon a normally functioning germinal epidermal layer and if this is absent, or not functioning, no tolerance can be established. Also the cellular regerative stimulus produces embryonic epithelial cells without the same degree of resistance that older cells have. Therefore the exposure time used in ultraviolet treatment of ulcers should not be increased until these cells have existed long enough to acquire the hardening of old established epithelium. Any increase at all is apt to be too drastic for these young cells. Also, for healing, it is necessary that the calcium content of the blood have its normal value. If response to ultraviolet treatment for ulcer is sluggish then systemic raying, which increases the calcium content of the blood, should be resorted to.

Liquid Paraffin for Cooling the Anticathode of X-Ray Tubes. T. Klason, M. D., Acta Radiologica, 2:197, No. 6, May, 1923.

THE writer reports very satisfactory results from the use of paraffin (which has a higher boiling point than water) to cool the anticathode of x-ray tubes.

When using water the tube begins to rock about from the motion of the boiling water within about seven seconds. When paraffin is substituted for the water there is no perceptible motion even after two minutes.

A Radium Compensator for Ionization Measurements. Rolf M. Sievert, Stockholm. Acta Radiologica 2: 156-165, No. 6, May, 1923.

The author's summary thus describes this instrument for rapid observation of the intensity of β and γ-rays. "The ionization current in a small chamber is compensated by means of another similar chamber, the latter together with a sensitive electrometer being placed in a lead box. The ionization in the compensation chamber is produced by the β-rays from a radium preparation, containing about 0.2 mgr. radium element. The compensation is brought about by increasing or decreasing the distance between the preparation and the last mentioned chamber accordingly, until the electrometer thread remains in its zero position, irrespective of a switch for earthing being disconnected or not. The distance is read off on a micrometer. Investigations of the possible error sources show that the measurement of one intensity can be made in 20 seconds without a greater error than one-half to two percent, depending upon the magnitude of the intensity."

Physical Facts of Roentgenological Importance. Arvid Odencrants, Ph. D., Acta Radiologica, 2:128-138, No. 6, May, 1923.

THIS paper comes from the Physical Institution of Stockholms Hoegskola Laboratory for Scientific Photography. It gives a brief summary of the physical laws underlying the science of radiology. It discusses the origin of the rays, continuous and characteristic spectra, diffuse and fluorescent absorption and the photographic and luminescent effects. The importance of the laws for practical work is stressed, especially is importance of exact terminology stressed.

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The Cause of the Action of X-Rays and Gamma Rays of Radium Upon Living Cells*

FRIEDRICH DESSAUER, Ph.D.

Director of the Institute of Physical Foundations of Medicine at the University of Frankfurt on the Main, Germany

THE CONTEMPLATION of histological sections, and even more remarkable, the macroscopic study of irradiated areas shows the profound effect of the influence of x-rays upon living cells. This enormous effect which may easily lead to complete necrosis of extensive areas strikes one more forcibly when the total amount of energy producing it is taken into consideration.

We can easily calculate the energy of x-rays which is absorbed by the body. For instance, the electrical energy consumed in a Coolidge tube delivering five milliamperes at 200 kv. in one second is 5.10^{-3}. 2.10^{5} watt seconds = 1.10^{3} watt second = 1 kilowatt second. The efficiency of the transformation of electrical energy into roentgen rays is about 1:1000. Therefore, the body receives about 1 watt second = 0 24 gram calories of radiation under the above mentioned conditions. A field of entry of about 100 cm.^{2} and 40 cm. target skin distance will receive about 1/200 part of the rays generated. Now, if half of the rays striking the field of entry are absorbed in the body this is equivalent to 1/400 of the rays produced. This in turn is equivalent to 1/400 of 0.24 gram calories as measured in heat units, namely: $\frac{0.24}{400}$ gram calories. Given a tube running fifty minutes under these conditions, the total amount of x-ray energy absorbed in the body is equivalent to (50 min. = 3000 sec.) $\frac{0.24 \times 3000}{400}$ gr. cal. or 1.8 gr. cal. or in even numbers 2 gr. cal. In other words, that is the amount of energy that will raise the temperature of two grams of water or of human tissue 1° centigrade. Hence, it is apparent that a hot compress or a swallow of hot water will give to the human body much more of the same energy than this energy of x-rays. But it is well known that this quantity of x-rays is capable of producing severe necrosis of cells and even the death of a human being. From this it may be deduced, that x-rays are indeed a very unusual therapeutic agent, and that the cells are profoundly in-

Professor Friedrich Dessauer, Ph D. Frankfurt am Main, Germany, whose work made deep roentgen ray therapy possible.

fluenced when the high frequency waves of x-rays are passing through them. During radiation the cells are placed in quickly oscilliating electric and magnetic fields at points where electric and magnetic forces are produced, disappearing and changing in direction, for that is the description of oscillations in a hitherto neutral place. The great problem which still remains unsolved today is as follows: What is the effect of the frequency V of the pulsating field upon the cells? The nature of the energy produced by the x-ray tube and striking the body is well known. We also know of the histological changes which such energy produces. But how the one effects the other, is still a matter of great uncertainty. Very often this question has been asked, and very often attempts have been made to solve it by biological methods of research. The activation and destruction of ferments, the exhausting of albumin and lecithin, the influence of internal secretion upon the blood and blood-forming organs and many other things have been thought of and considered as possible explanations of it. Lately the stimulating effects which are produced by relatively small doses have rightly attracted the attention of the biological workers. They touch the problem of the general systemic effect of radiation upon the body as a whole. It is a biological fact that all cells are effected by radiation, but in very different degrees. The laws governing these effects have been given by Hertwig-Bergonie and Tribondeau, viz: the young undifferentiated fast growing cells are more sensitive to x-rays than adult tissue, but not as formerly stated, the cells having active metabolism.

On the other hand, we have some idea of the transformation which occurs during the absorption of x-rays in gases. We can follow this process especially through the splendid and well-known experiments of C. T. R. Wilson. Many a thing is known in this regard, even quantitatively. The absorbed x-rays liberate electrons, in the kinetic energy of which—according to the newest explanation—all the energy of the x-rays is completely recovered. These electrons are repeatedly caused to deviate and travel in a zig-zag course through the gas, forming, step by step, gas-ions which form nuclei of condensation and are, therefore, easily seen in the photos of Wilson. In these experiments there

*—Read by Ernst A. Pohle, M.D., Assistant of the Institute, at the Annual Meeting of the Radiological Society of North America. Detroit, Dec. 5, 1922. Dr. Pohle wishes to thank Dr. N. Moore of Grand Rapids and Dr. Georges Thomas of Cleveland, who kindly assisted in the translation of this article.

are formed drops of water that can be very brightly illuminated by a flash and therewith photographed and thus show the position of thousands of ions and in this way the path of electrons. The pictures have been given so many times in different publications and shown in lectures that I do not think it necessary to reproduce them here.

The electron when forming an ion loses a part of its energy and, therefore, its velocity gradually diminishes and finally the electron comes to rest. The ions can exist in a closed space a long time, but finally they combine with each other. As the end result of the transformation, a small gain in the kinetic energy of the gas molecules will be recorded, identical with a slight rise in the temperature.

Experimentally, it has not been possible to prove that the disintegration of the x-rays in tissue takes place in a similar manner with the formation of electrons (with the kinetic energy equal to absorbed x-rays), in the first step, with the formation of ions (with a number and distribution of ions depending upon the kinetic energy of electrons) in the second step, and in the third step, by collisions during ionization and by recombination. But in any case, the final result must be heat. There is no doubt that in a very short time after the absorption of the x-rays, the energy has changed into heat. Between the first and last step we must look for the biological effect.

The proof of the disintegration of high frequentcy rays through electrotransformation into heat is well seen by the so-called "photo effect." Light rays striking the surface of many materials, particularly those of alkali metals cause them to emit electrons and cause the metals to become positively charged. The field stress of the incident rays gives the electrons sufficient impulse to enable them to leave the surface of, for instance, a piece of potassium. Generally, this effect upon liquid surfaces is very small; water shows very little emission, whereas, ice gives three hundred times as much and with shorter waves even more. The presence of a very fine colloidal skin upon color solution produces this otherwise absent effect. The electrolytic character of a liquid has no influence upon this property, although the experiments made by Swenson with salt solution seem to show positive results.

This photo-electric effect of Hallwachs takes place in every case where the rays strike solid bodies; electrons with remarkable initial velocity are emitted into space and, therefore, can be observed. So it appears that the absorption of rays is accompanied by the emission of electrons and thereby all the energy of the absorbed waves ($h \times v = e \times V = \frac{mv^2}{2}$) is completely retained. This is shown by reference to Einstein's and Planck's law and was proved by many experiments in the "volt velocity" of the electrons (of course in their kinetic energy too).

Biological experiments made by Caspari and Aschkinass and Halberstaedter, speak for the theory that the effect of the x-rays is due to the formation of electrons. Cultures of bacteria have very high resistence to x-rays and perish only after very prolonged irradiation. Yet the effect of the rays may be greatly changed if the experiment is so arranged that the rays are transformed into the motion of electrons and the electrons strike the culture. That is a very simple experiment. It is so arranged that the x-rays penetrate from below through the bottom of a Petri glass. Immediately above the culture, a plate of high atomic metal is placed in such a manner that the lower surface is struck by the x-rays (Halberstaedter's experiment). The culture is now quickly destroyed, the destruction is caused by the electrons that are going down from the plate and correspond to the form of the metal plate. That this effect is not due to secondary x-rays is proved when there is interposed a thin piece of paper which is almost non-transparent for electrons and quite transparent for the x-rays. It seems that the small effect of the x-rays on the culture in the experiment without a piece of metal may also be caused by the electrons and that it is so very small because so very few secondary electrons are produced in the culture in comparison with the number of electrons emitted from the metal of high atomic weight.

Yet it must not be concluded that there is a relation between the action upon the cells and their contents of heavy elements such as iron, calcium, etc., for no trace of such a relative sensibility has been proved. The difference in sensitiveness of rays does not seem to be based upon such primitive actions but to be purely biological.

I will give some other biological observations before I return to the physical side of the problem. Plant seeds in a good dry condition are not sensitive to roentgen rays even when they are very heavily irradiated. But when moistened they begin to germinate and become very sensitive. This effect may be ascribed to the influence of water, but it may also be due to the stage of germination. Organs, skin for instance, kept alive in vitro, are very much less sensitive than in vivo. These facts do not appear to offer an explanation of any kind, but we shall soon see that they admit certain physical inference.

Then physically it is probable that the connection between the absorbed wave energy of x-rays in tissue and the biological result is through the electrons. The experiment with the culture of bacteria and the strip of metal could be duplicated in the living body producing, however, only a very superficial effect. The intense effect of the beta and cathode rays upon the skin prove it (Caspari, Aschkinass, Strebel). Then the above considerations admit that the secondary electrons generated by x-rays (they are often named "secondary cathode rays or beta rays" as they are also electrons in motion) are the substantial cause of the biological effects and that x-rays may be accepted as excitors of this kind of energy (the velocity, length of path) and distributors of the energy which may differ widely according to the quality of the rays. In another place, I have shown that the difference in the distribution using soft or hard rays may be about 1:30000.

What is the action of the electrons in the human body? In gases they are ionizing, but are they in the human body?

Physically, the human body may be regarded as a system of electrolytes, colloids and membranes. This affords sufficient possibilities. After conversation with Professor Friedrich Kraus of the second medical clinic in Berlin, with Prof. Caspari and my friend and coworker, Dr. R. E. Liesegang, experiments in my institution have been made, mostly by Dr. Janitzky, to discover any effects or disturbances, due to ionization during the absorption of x-rays. Previously, Friedrich and Schwarz studied the effects of catalyzers.

The final results of the experiments are at present unfinished, but their results will be published later. It is energetically quite possible to prove that ionization changes the conduction in an electrolyte even if only a very small fraction of the energy of the electrons is transformed into provable ionization. But the question arises: can the ionization due to absorbed x-rays be found at all in an electrolyte? That is easily made clear through a calculation. The experiments in gases show that the ions have received sufficient velocity to move away from each other. They cannot re-combine as the electrostatic forces decrease with the square of the distance. The result is the ionization of the gas which is the basis for electroscopic and ionization measurements. Considering, in the first place, that the length of path of the ions is reduced with the density of the media, their

paths in the electrolytes would be reduced a thousandfold more than in air. The Coulomb force of re-attraction would be as the square of the path travelled, in this case 1,000,000 times greater than in gas, but owing to the di-electrical constant being 80 times higher, therefore, the result would be only about 10,000 times larger, assuming that the initial velocity (measured in volts) is the same as in air. With less velocity, the re-attraction would be still greater. At all events, from the consideration of this subject, it is clear that in an electrolyte the possibility of an electron travelling so far that it is not again recombined, is 10,000 times smaller than in gases. It is highly improbable that there can be found such a change in conductibility of the electrolyte due to ionization and that the biological effect could be produced by ionization, when the body is regarded as an ordinary electrolyte.

Then I had the idea of preventing the recombination of the ions by adding highly dispersed colloid in such a manner that a colloid particle should be at once interposed between the separated ions. Such and many other experiments to ascertain the difference in result from rays of different wave lengths, the influence of membranes, the reflection of electrons in the Halberstaedter experiment, and the addition of different material produce an interesting effect. But it is very improbable that this effect, which is extremely small, can produce such enormous changes in cells. Results up to the present do not prove that the process of x-ray transformation is through the electrolytic changes in tissue by means of electrons and stable ionization. The ions are speedily recombined. One must not expect large disturbances in conductibility or in the condition of the membranes. Also, the changes of catalyzing processes under radiation observed by Friedrich and Schwarz are very small. Before I give any other theory which serves me now as a working hypothesis, it is well to mention the photo-effects of x-rays. These latter also are, on the average much smaller than in the absorption of visible light. It is altogether impossible to explain with the photo effect the profound influence of x-rays upon the surface or the deep parts of the human body.

A possible explanation that I have in mind and that is supported by a number of observations is based on the fact that the formation and recombination of ions by the absorption of x-rays must be combined with kinetic effects. The impulse which reaches the cell molecules is considerable (both for the molecules first bombarded and for those afterwards struck). These impacts, the sum total of which is a large amount of kinetic energy in a very small space, may be regarded as a considerable rise of temperature in this very small space, which has to take place because the consequent dispersion of the heat at sinking temperature will naturally require a certain lapse of time. Undoubtedly the whole of the absorbed energy of the rays is converted into heat, that is, kinetic energy of the particles of the heated space. The total heat produced, as previously calculated, is exceedingly small, but heat is regarded as distributed over all the molecules of the heated space. The active effect is at every moment confined to very few molecules and groups of molecules. Concerning the heat, I would like to speak about "point-heat" which signifies a very high rise of temperature that suddenly comes into a molecule and into the adjacent cells. For example, a micro-observer who would see the molecules like dust particles in sunlight would observe them glowing up everywhere interspersed between millions of indifferent molecules and zigzagging in all directions as in the Wilson photos. Similar explanations have been offered physically of the impact of alpha-particles and beta-rays of which the kinetic energies and the "temperatures" of course are still higher. There are many analogies for such "concentrations" of energy before its diffusing. Professors Cermak, Giessen, mentioned in a conversation as an example, a lake into which small meteors might fall. The kinetic energy of the meteor-stone which raises the temperature of the lake and disturbs its level but slightly, is at the first moment very remarkable, because locally concentrated. The water spouts out a meter high, whereby a sensitive object near this spot may readily be destroyed.

Sensitive undifferentiated cells undergoing mitosis, will be damaged, when such "point-heat" is developed in their nuclei. Growing processes are very sensitive to heat and cold. Tissue living in vitro has a few numbers of cells undergoing kariokinetic change. As yet there are no forceful arguments in favor of my view, but the fact of such a localized concentration of energy in the time of its reforming into heat is absolutely certain, while the process of a definite extensive considerable electrolytic change, is very improbable. As far as I know, no satisfactory experiment has been conducted about the relationship of the electrolytical nature to the sensitiveness of rays. The two following ideas seem to me to be especially important for my theory. The "point-heat" effect is limited to points at which the electron loses a part of its kinetic energy by impact. A chain of points, very much closer to each other than the gas particles of Wilson's experiments will be produced. If at these points are situated sensitive cells, especially nuclei, in critical states which cannot endure the temperature impacts upon a part of their molecules, they will suffer. If they have a higher resistance, such as muscle cells, they will be able to resist. Therefore, the sensitiveness is not a physical but a purely biological quality, as borne out by experience. It is of no account that red blood corpuscles contain iron and have, therefore, high absorption capacity, but it is only important if they are able to withstand the impact of the "point-heat." The white blood corpuscles are sensitive purely for biological reasons.

The other argument is the following: If the above theory is correct, the particles struck will be distributed very irregularly throughout the irradiated zone, according to the laws of probability. If we think about cells of one type that ought to be influenced (carcinoma cells, for instance) and for the purpose of simplifying the problem, we assume equal biological sensitiveness, distributed evenly in the irradiated zone, it is then easy to imagine that during sustained radiation the number of carcinoma cells affected will increase. Very soon many of them will be struck for the second and third and multiple times, whereas others have not yet received the first impact. The number of carcinoma cells not struck once will decrease as radiation proceeds, but the rate of decrease becomes slower and slower, whereas, the number of cells struck a number of times, will increase. Necessarily, after a prolonged radiation the following will have taken place: most of the carcinoma cells will have bee struck several times, others a hundred or a thousand times, when the average effect has been obtained with the treatment, yet a few cells must remain which have not been struck once.

These facts can hardly be explained by the conception of "absorption of waves" in the sense of classical physics or by electrolytical changes. But the consequence of the "point-heat" theory, that after sufficient irradiation of practically similar cells of nearly equal sensitiveness the majority have been destroyed, and many others severely damaged and others have not been influenced, is proved by experience. Their number is reduced with prolonged overdosage, but the unaffected cells do not disappear altogether and careful experiments have frequently shown this very surprising fact. Besides the experiments and notes of Caspari (the biological foundations of deep therapy) I might mention the work of Dr. Wood, who found in a great number of ani-

mals a somewhat exponential diminution of inoculating neoplasm cells with the increase of irradiation dosage.

The question that interests us mostly and that can be sometimes controlled (biologically, for instance, by means of counting such as is done with blood corpuscles or photographically by means of blackening—measuring, analogical to discolorations, changes in viscosity, etc.) is the question as to the state of the particles in unit volume after any definite time of the radiation.

In such a unit volume (1 c.c.) between other particles of a certain known and similar sensitiveness there can be, for instance M carcinoma cells. In comparison with the space of initial action of the point-heat which we consider acts upon small molecule groups, a cell will generally be very big. According to its sensitiveness it will endure one or a greater number of impacts before it will sensibly suffer in its life (albumen coagulation, analogical to infection-like reduction of halogen silver starting from one or several points).

A single x-ray at its disintegration is able, as shown by calculation, to produce thousands of such point-heats. We will designate by M_r the number of those particles that after a given observation time generally have not suffered any influence, by o a "radiation coefficient" which depends chiefly upon the clearness and kind of light, also probably upon the size and disposition of cells; then this rest of unstruck cells is

$$M_r = M_o e^{-oT} \quad \text{(1st)}$$

where e is the base of natural logarithms.

This signifies that with progressing radiation the number of these rest-cells will decrease at first quickly and afterwards more and more slowly.

In the same time T a great number of the cells struck only once will be struck the second time, any of those struck twice will be struck the third time, etc. Finally, the cells struck n times, will be struck n l times. In practice, it is important to know the number of impacts which result in the destruction of the cell (the plain blackening of halogen-silver, etc.) The following impacts have no such importance, nor any other action.

If the particles struck at all (at least once, and between these, such as are struck 2, 3, ... n and n x l times) are marked with M^1, then it follows:

$$M_1 = M (1-e^{-oT}) \quad \text{(2nd)}$$

The particles struck twice and more would be called M_2, those struck thrice and many more times would be called M [illegible] to M. Each time there re- [illegible] residue. As M_r signifies the number of particles never struck, the number of such particles which now after the time, T, are struck only once must be $M_{r,1}$

If any certain time is considered, then in the next following moment the number of particles struck only once will be changed. This number will be increased by the number of particles that in this infinitely short time come from the number $M_{r,a-1}$ and will be decreased by those which fall away owing to the following point-heats from the order $M_{r,a}$. The treatment leads to an integral that is equal to radioactive transformation products with equal destruction-constants. In the case that there was no influence in the time O the result for the particles is as follows:

$$M_{r,1} = M_o oT.e^{-oT} \quad \text{(3rd)}$$

Generally for the $M_{(r,a)}$ particles, that is, those that have been struck only a times:

$$M_{(r,a)} = M_o e^{-oT} \cdot \frac{(oT)^a}{a!} \quad \text{(4th)}$$

In the direction of these calculations lies the possibility of quantitative determination of influences, as well as the outlook for radiation, if in a given case something is known about the distribution (through counting) of the cells. Then it will be possible to find out whether the radiation is permissible or not, according to the mixture with normal cells of less sensitiveness of which not more than a definite percentage may be injured, without menacing the body.

The physical meaning of the irradiation—coefficient *(o)* of point-heats.

From the general equation—

$$M_r = M_o e^{-oT} \quad \text{(1st)}$$

where M_r is the number of the residual particles, particles not yet struck in the time, T, and M_o is the number of all particles, then

$$-\frac{dM_r}{dT} = oM_o e^{-oT} = -oM_r \quad \text{(5th)}$$

thereafter

$$o = -\frac{\frac{dM}{dT}}{M} \quad \text{(6th)}$$

The meaning of O is, therefore: The part of the residual particles that falls away in the given time unit.

Between the ordinary heat-motion and the point heats exists at first a considerable time difference. But with the usual heat-motion it happens that a large particle gets by addition of impacts from the same direction exceptional velocity and, therefore, differs from its surroundings, and so with very low general temperature evaporates. But with the action upon the halogen silver particles, cells, gelatine particles, etc., coming into the question, the point-heat signifies that little groups of particles differ very strongly from the average motion-state of others (for a short time) without influencing considerably the state of the others. Then, as the example that we had before shows, the water spouts out highly where the stone has fallen into the lake, but the surface of the lake and its temperature do not show any considerable change. If a piece of gelatine be made more fluid by heat, then in this experiment the average state of all gelatine particles (of large size) will be almost the same after several minutes. The whole piece of gelatine as far as it can be measured, appears to be warmer. If a hen's egg is coagulated by the temperature it is then equally heated and coagulated. If this is the result of point-heat, then there is no general temperature-raising. The temperature-raising conserves (as is self-evident and also evident by ways of calculation) the single big particles we are interested in, and in time almost equally, but the point-heat occurs only after an exponential-function. With the point-heat in every moment the relation of the energy-concentration in comparison with the surroundings is much greater. It may be asked which mass-complex can generally take part in the phenomena of point-heat. At what least number of moving particles may we speak about heat? The ionization and recombination in the first moment concern two mass-particles, the absolute weight and specific heat of which are known, but it results, that energy imparted to these particles may correspond with the immense temperature, if indeed one can speak here about temperature. It seems to be more conclusive to consider the question going out from the disposed energy and to reflect upon what amount of mass can be heated with this energy to such a temperaure, which has any influence upon the process concerned here. This amount of particles of matter I should call "the critical amount." If the energy spreads on to a larger number of particles, then the energy-concentration will be too small for this phenomenon to produce anything measurable.

The above mentioned facts will be clear by means of the following example: Let us imagine a cube of specific weight and specific heat = 1, consisting of albumen-molecules with the molecular weight 5000, then we can say, that the temperature of about 100° is critical for an albumen-molecule, because at about 50° albumen begins to coagulate. If we calculate with 100° and a specific heat equal = 1, we find the loss of electrons, about 12 volts, would signify such an ionization-energy, which in the heat expressed would heat

such an albumen-molecule over 100°. If this energy spreads onto a mass 10 or 100 times as large, then the temperature will be too much decreased and nothing in particular can happen further. The sense of the point-heat-theory is that the action must be distributed not equally to all the particles, as it may really be thought in the average at the heating, but it must be concerned with the place, where the heat is concentrated on a very small "critical mass" and produces a critical accumulation (temperature).

If for instance the radiation with x-rays produces very quick electrons, then we can suppose that within one single cell which is made up of an immense quantity of molecules, there is produced in the path of an electron a very large number of point-heats. We can also think that any of the impacts correspond to a larger loss in volts of the electrons. At the small tension-loss, where the ionization-work is about two volts this work must approach the limit where it no longer acts and, therefore, does not produce any more changes and does not react on the photographic plate, or human cell, or anything like that, excluding perhaps (if O is too large and if many such impacts are produced in the same time and at the same place) fluorescent flashes. It may be thought that, with the absorption of x-rays as a result of point-heat, dissipation takes place, occurring not only on the surface, but also in the depth.

The experimental examination of these ideas is a part of our program, but is still incomplete.

As it is very easy to calculate how much ray-energy enters through one square centimeter of surface radiated and how much energy is absorbed in one cubic centimeter, so it may be shown by means of simple calculation, how many point-heats are produced in one second in such a cubic centimeter of body irradiated, by supposing that the energy of such an impact (which is a product of the unit-charge on the speed-loss) corresponds with the number of 10 volts. This number can be compared with (also approximately calculated) that of albumen-molecules or even of cells or of photographic particles in such a tube. This is the value of O for the albumen molecule of cells, etc. It can be computed and then compared with the experiment. We have compared in the Institute (Dr. Blau and Dr. Altenburger) our results with other published material, especially in photographic literature and several results were good. This will be the subject of a special publication.

The discussion as to whether x-rays of different hardness are different medicaments or not, is given, owing to this consideration, a very clear basis. In certain aspects the action of light, soft x-rays and of hard x-rays, is on the whole similar. If the point-heat-theory is right, then the statement above mentioned is to be explained in the following way:

All these three kinds are acting by means of point-heats and now it is possible, that at the irradiation even with the different wave-frequencies the disintegration of their energy goes in almost equal portions, for instance, each time the energy is about 10 volts multiplied with the unit-charge. Then the action upon the particles, the size of albumen-molecule which have been struck once, are equal, but already in relation to a cell they are quite immensely different and still more different in relation to a cell-complex. And as we have above calculated, the same amount of energy absorbed in any place, influences 100,000 times as many cells, if the frequency is only 10 times as great. Then, owing to this cause, the rays of different hardness are different medicaments, but it may be the case that the waves of different frequency which liberate the electrons of different velocity, are disintegrating in differently large steps, that is, that the quick electrons are able to lose a different number of volts than the slow electrons. In this case the point-heats are quite different among themselves.

Local and Stimulating Action

The number of the particles struck decreases at first quickly, and afterwards more and more slowly. Practically the rest is unimportant, if the total radiation was great, but we can always find sensitive cells which are not damaged.

Further, there are always destroyed a certain number of relatively more resistant cells in which various changes have taken place.

These two consequences following from the theory do not at all deny the value of radiation in therapy. But they are showing what is to be expected.

After each radiation, cells of all kinds are injured, the sensitive cells in a far greater percentage. For example: If ninety per cent of the carcinoma cells in the radiated area are killed, perhaps five per cent of the essentially resistive cells (normal skin, bowels, epithelium) in this zone are likewise similarly destroyed, and also all the other cells in a certain percentage, namely, those which by comparison with the average have endured a very great number of bombardments. But it is true that even at any small radiation some of the cells must be destroyed; it is indeed the case with the more sensitive cells, and it happens also with less sensitive cells. The calculation thus shows that even with a small radiation some cells will be struck many times. It may be accepted, that many phenomena, which, especially recently, are known as stimulating action, proceed from this. The word "stimulation" receives now a definite content, which it has not previously had. Any part of the body or a plant is so irradiated that according to the order of size only small percentages of that energy are absorbed, as at the ordinary radiation, which leads to the macroscopic effects (reddening and so on), then it is not at all uncertain, that the actions of the point-heats upon single cells are so accumulated, as these cells are injured. The microscopic inspection shows, that all this can have taken place. Nevertheless, in accordance with Caspari's ideas the processes of cell-destruction, must now act in the circulation and can produce very severe reactions, which, contrary to ordinary radiation effects are primarily not local. Secondarily, they can indeed be local, that is, localize themselves at any place in the body, because in that place is disposed a certain organ or there is a locus minoris resistentiae. By that there occurs from the stimulating action another entirely different and remote phenomenon, viz., the local destruction. The stimulating action has a basis in the injury of a correspondingly small number of cells, upon which the body reacts by compensating or overcompensating. My opinion is that from the investigation of this phenomenon much is to be expected.

It seems perhaps too early and too hazardous to publish such a theory without encircling calculations and without experimental examination, only, so to speak, with a sketch and with only qualitative reasons. But I venture to do it because we in our Institute seem to have found some confirmation of a quantitative kind, which may be published later. Also because it will sooner be established, how far this representation coincides with the facts and whether it can be useful as a working hypothesis provided that scientific men become acquainted with it. Whether this theory has little value or whether it is entirely wrong, will more quickly be found out in this way. On the other hand, if it is correct, then by this means it will the sooner become useful.

Roentgenologic-Pathologic Conferences*

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THE PURPOSE of this joint paper is an attempt to promote cooperation between the roentgenologist and pathologist. The roentgenologist who is confronted with the varied problems presented in a general diagnostic x-ray laboratory presents conclusions which have much or little value according as they are based upon proper concepts of pathology. The most important preliminary study for the roentgenologist is pathology. His book shelves should contain as many volumes on pathology as on roentgenology. If he is to be progressive, he must be a constant student of pathology and embrace every opportunity to examine the contour and density of the organs of which he has records upon his plates.

At the University of Michigan every Friday afternoon during the school year there is held a pathologic conference, in which the clinicians and roentgenologists give their clinical diagnoses and where the pathologist as the court of last resort gives the macroscopic and microscopic findings. The correrlation between the clinical symptoms as shown by the methods of physical examination and by the roentgen ray is reviewed and commented upon in the light of autopsy data. The advantages of such a weekly conference are: first, the stimulus to careful and precise work; and second, the opportunity either to be fortified in the data of complex cases, or to profit by mistakes.

Many roentgenologists fall into routine habits of procedure and do not always stop to question whether these are based upon fundamental concepts of pathology. It is only by the maintenance of a constant relation between the roentgenologic and pathologic laboratory that essential progress will be made. The following cases chosen from the clinical-pathologic conferences at the University of Michigan will illustrate the method and serve to emphasize the practical value of such cooperation between the clinics and the pathologic laboratory.

CASE I.—M. H., age 38—*Department of Dermatology.*

Clinical History: Admitted to the hospital on August 4th, 1922. At the time of his admittance his complaint was a swollen left testicle.

Fifteen years ago developed two hard painless penile lesions following exposure. These were cauterized; no subsequent eruption or sore mouth. In November, 1921, he developed a swollen testicle which was very painful. Two months before examination, Wassermann examination was positive and he began taking mercury by mouth and by inunctions with no relief of symptoms. Examination at entrance showed left testicle about the size of a hen's egg, consistency of a rubber ball, almost cartilaginous; surface nodular. No involvement of vas deferens. Slight general adenitis. Wassermann 4 plus. He was given injections of arsphenamin on the 7th, 11th, 18th and 25th of August and 1st and 8th of September. On the 8th of September he became suddenly cyanosed and dyspneic and died before any treatment could be administered. The admittance diagnosis was gumma of testicle.

Postero-anterior stereo of the chest: Examination of these plates show both lung fields almost completely filled with numerous spherical dense shadows of varying sizes and densities from the size of a shot to the size of a small orange. Both extreme apices appear to be clear although there are no especial lung fields selected for predominance of these shadows. This is certainly not

Fig 1—Case I. Posteroanterior plate of chest. Rounded shadows represent metastatic areas of neoplasm. X-ray report, shadows sarcomatous. Pathologic report showed them to be carcinomatous, metastasis being by the hematogenous route, from a primary malignant teratoma of left tests.

tuberculosis, as the involvement does not appear to have increased the bronchovascular structures. These shadows appear more to resemble those of sarcoma metastases.

Stereoscopic plates made of the pelvis showing the upper thirds of the right and left femora. The hip joints are symmetrically shown, and show no evidence of bone pathology. The plates are made too low to show the lower spine.

Pathological Report: Autopsy 1342—A-23-AA—Department of Pathology, University of Michigan, Ann Arbor. M. H., age 38, male. Died 9-8-22, 9:05 P. M. Autopsy 9-9-22, 12:30 P. M. Clinical Diagnosis: "Gumma of Testis? Lues. Cause of death, cerebral embolus?"

The complete pathological findings in this case were: Malignant teratoma of left testis (medullary carcinoma with sarco-carcinomatous areas). Multiple metastases in lungs, liver, spleen, bronchial, mediastinal and cervical lymph nodes, retroperitoneal lymph nodes and capsule of left kidney. Ascending lymphogenous metastasis, most marked on left side. Thrombosis of left external and internal iliac veins with multiple pulmonary emboli. Congestion and edema of lungs. Atrophy, congestion, edema and parenchymatous degeneration of all organs. Early atherosclerosis of aorta and iliacs. Atrophy of pituitary and parathyroids. Excess of chromaffinic cells in adrenals. Total aspermatogenesis.

Pathology of Thorax. Diaphragm was at the 6th interspace on the right and at the 7th on the left. No free gas or fluid in thorax. Pleural cavities completely obliterated by old adhesions. Both lungs were very voluminous, lung borders nearly meeting in the mid-line. The anterior mediastinum contained many enlarged lymph nodes. No remains of thymus were seen. The apex of the heart was inside the nipple line behind the sixth rib. Slightly enlarged. Pericardial sac negative. Heart negative with the exception of a moderate dilatation of the left ventricle, and slight sclerosis of the larger coronary branches. The lungs were completely covered with pleural adhesions. Beneath the visceral pleura and occasionally extending into it were numerous round nodules varying in size. On section the cut surface of the lungs showed numerous circumscribed, round, soft medullary nodules of a yellowish or greenish

*—From the Departments of Roentgenology and Pathology, University of Michigan, Ann Arbor.
*—Read Before the Meeting of the Radiological Society of North America, Windsor, Canada, December, 1922.

color, presenting cheesy, necrotic centers. They varied in size from that of a pea to a base ball. The smaller areas were firmer, more creamy in color and showed less central softening. They presented the appearance of a metastatic medullary neoplasm of carcinoma type. The cut surface of the metastases yielded on scraping an abundant cell juice. Between the nodules the lung tissue showed marked congestion, edema and atelectasis. In one of the primary divisions of the left pulmonary artery a mixed embolus was found. The bronchial nodes were greatly enlarged; on section they presented the same appearance as the nodules in the lungs, and the metastases found in other parts of the body, and the primary growth in the left testis.

The microscopic examination of the primary mass replacing the left testis showed it to be a neoplasm of the type of a medullary papilliferous cystocarcinoma. In localized areas the stroma was so cellular as to warrant the use of the descriptive term "sarcocarcinoma" for such areas. No other teratoid structures were found, but the type of the neoplasm is that of one of the more common malignant transformations of testicular teratoma. The metastases throughout the body present the same neoplastic type as that of the primary. The metastasis is both lymphogenous and haematogenous. The marked involvement of the lungs is a characteristic common to all forms of malignant testicular tumors.

No histological changes of syphilis were found anywhere in the body. The clinical diagnosis of lues is unsupported by the pathological findings. We believe he did not have syphilis. The positive Wassermann is explainable by the advanced carcinomatosis. In our experience a 4 plus positive Wassermann reaction is of frequent occurrence in patients suffering from advanced carcinoma or sarcoma, particularly when such malignancy is of teratoid origin.

The pathological findings support the x-ray diagnosis of metastatic neoplasm in the lungs. Because of the sharply-defined and regular outlines of the neoplasm shadows the growth was regarded as either sarcoma or hypernephroma by the members of the radiological staff. It was neither; it was a carcinoma. The differential diagnosis of metastatic sarcoma and carcinoma of the lung in the x-ray plate, on the grounds of difference in the manner of metastatis, hematogenous or lymphogenous, can not be supported from a pathological standpoint. Both metastatic carcinoma and sarcoma may present the same x-ray appearance.

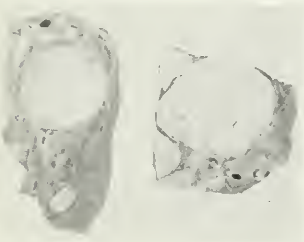

Fig. 2—Metastatic carcinoma nodules in portions of lung (natural size), from primary malignant tertoma of left testis.

Fig. 3—Photomicrograph of metastatic adenocarcinoma, from primary malignant adenocarcinoma of left testis.

CASE II.—M. S. W., age 7—*Surgery and Pediatrics.*

Clinical History: Entered the hospital on the 12th of November, 1921, with swelling of the right foot and right inguinal glands. Two months previous to entrance, swelling of leg appeared, and increased rapidly with no constitutional symptoms. A growth was removed from the leg previous to entrance into the University Hospital. On the right foot is a swelling of the dorsal surface over the metatarsal, size of a walnut, not tender on manipulation. Inguinal glands palpable and matted. On the 21st of January, 1922, the growth on the foot was removed, also part of the glands in the inguinal region. The operation was followed by a series of x-ray treatments during January and February, 1922.

He was discharged from the hospital on March 29th, 1922, and readmitted April 29, 1922. There was a recurrence of the tumor on the foot. X-ray treatments were resumed. Local operation on the foot. On September 7, 1922, the foot was amputated. In October he complained of pain in the back with incontinence of urine and feces. The latter part of October, 1922, there was a loss of sensation below the area supplied by the second dorsal nerve. Paralysis of the bladder developed. The patient grew gradually worse with slow respiration and rapid heart action. Death occurred on November 1, 1922.

Examination of Chest: This patient has had a former examination of the chest, and comparison of these plates with those of the former shows evidence of appearance of a new shadow in the chest. This is dense, sharply outlined and appears high on the right side posteriorly and beneath the first, second and third ribs. We take this to be a shadow of metastasis into the posterior mediastinal space or possibly into the lung, as we are unable to determine accurately its location from these plates.

Pathological Report: Autopsy 1366. A-47-AA. M. S. W., aged 7, died 11-1-22 at 2:00 P. M., autopsied at 1:30 P. M., 11-2-22. Clinical Diagnosis: Generalized sarcomatosis, primary in right foot.

Pathological Diagnosis: Multiple metastases of an alveolar large round cell sarcoma (primary in right foot; amputation two months previously). General atrophy and passive congestion. Acute cystitis. Left hydrothorax.

Pathology of Thorax: Diaphragm lower border of fourth rib on the right, upper border of fifth rib on the left. No gas or air in thoracic cavity. Apex of heart in fifth interspace in midclavicular line. Left lung completely atelectatic. Left pleural cavity contained 700 c.c. of a clear straw-colored fluid. No thymic tissue visible to naked eye. Heart slightly enlarged, otherwise negative. Left lung showed nearly complete atelectasis, only a small portion of the peripheral portions being air-containing. Scattered over the pleural surface and throughout the lung parenchyma were numerous firm, round, whitish nodules, varying in size from that of a millet seed to that of a hickory nut. On scraping, the nodules yielded only a small amount of tissue-juice. Between the nodules the lung

Fig. 4—Case II. Posteroanterior plate shows adventitious shadow in upper right lung field, suggestive of neoplasm.

tissue showed atelectasis, congestion and edema. The left bronchial nodes were greatly enlarged, on section they presented the same appearance as did the pulmonary nodules. The entire parietal and diaphragmatic pleura on the left side was studded with similar metastatic nodules. Extending from the diaphragm, along the pleural ligament to the hilus of the left lung there was a thick cord of neoplasm of the same characteristics. The right lung was air-containing throughout. There were no pleural adhesions on the right except at the apex, and no fluid in the right pleural cavity. On the right apex there was a metastatic nodule of the size of a plum, growing from the parietal pleura into the apex of the lung. On section, only a few small metastases can be seen scattered through the lung tissue. The right bronchial nodes were not enlarged. With the exception of the apical nodule, the parietal and visceral pleurae on the right showed no other metastases. Lung tissue showed no other changes except congestion and edema. No metastases were found in head or in the bones. The spinal cord was not examined.

The microscopic examination of the nodules from the lungs, bronchial nodes, chest wall and diaphragm showed the structure of an alveolar large round cell sarcoma; in the older metastases the cells were oval, or slightly spindle shaped. The metastases in the retroperitoneal glands, peritoneum, kidneys and right popliteal space showed the same structure of alveolar sarcoma. This accords with the structure of the primary growth in right foot, as shown by repeated diagnostic examinations made in the laboratory from tissue taken from the foot-growth before and after amputation of the foot. In the earliest specimens the cells of the sarcoma were more uniformly spindle-shaped; with recurrence and generalization the growth was more rapid and less differentiated, so that in the majority of the nodules they were round. Originally an alveolar spindle-cell fibrosarcoma the neoplasm at this stage presents the appearance of an alveolar round-cell sarcoma.

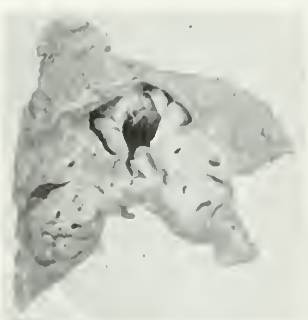

Fig. 5—Gross appearances of lung of Case II. Metastatic alveolar round-cell sarcoma of bronchial nodes and lungs; primary in right foot.

The x-ray plates of this case were taken nearly three weeks before death. At autopsy nothing was found on the right side to explain the shadow seen on that side beneath the first, second and third ribs except the localized metastasis and pleural adhesion at the right apex. The nodule in the pleura was about the size of a medium-sized plum; when cut into, it was found to be adherent to the first costal cartilage which was completely encircled and thickened by the growth. The size of this localized metastasis was entirely out of proportion to the shadow, and does not seem sufficient to explain it. On the other hand the plates show no evidence of the extensive metastases and hydrothorax on the left side. The development of these conditions can, therefore, be assumed to have taken place, for the greater part, in the interval between the taking of the plates and the death of the patient.

CASE III.—R. E. H., American, age 26, a farmer by occupation.

Clinical History: His complaints are, sour stomach with gas, burning pain and eructation. In the patient's own mind the trouble began at the age of 15. At that time he was struck in the abdomen by the handle of a plow and for four years after had irregular, somewhat infrequent attacks of "stomach trouble." At the age of 19, his symptoms became so annoying that he sought help in a hospital in the northern part of the state. He returned home without improvement. While in the hospital he learned the use of the stomach tube and he has been using this continuously ever since. On some days he has pumped his stomach as often as five or six times. He vomited occasionally before he began to use the stomach tube, and very infrequently since and only at such times when he was too far away from his tube to get it before vomiting would come on. He has seen fresh blood on only one occasion during the last spring. There has never been any bright blood in stools. He has always enjoyed good appetite, even up to the present time. His maximum weight was 172 pounds. He weighs 127 pounds at the present time.

Ward Notes: He entered on the 22nd of September, 1922. On the 26th he was complaining very bitterly of a burning pain in the mid-epigastric region. He had not been permitted to use the stomach tube while on the ward. He had been observed to eat anything that was offered him in the usual house diet. On the 1st of October, about 10:30 A. M., while the ward doctor was at the patient's bed, he picked up a glass of liquid nourishment and as he was about to place it to his lips, it dropped into his lap and immediately the patient went into a tonic convulsion, with marked contractures, passing very shortly into a clonic convulsion which lasted possibly a minute and a half, at the conclusion of which he was markedly cyanotic, eyeballs rolled upward, pupils contracted, resp'rations labored, extremities cold. At the end of a ten minute period he still failed to respond to questions or to marked skin stimulation. On the following day he was still in a semi-comatose condition and would respond to a sharp command by opening his eyes and staring blankly. He made purposeless movements with his right hand, seeming to be attempting to touch the top of his head.

At this period in the patient's stay, his sister appeared, and on questioning her it was learned that the patient had had similar seizures previously. The first occurred last May. This was the third to her knowledge. Upon the two previous occasions it was stated that he had remained in the semi-comatose condition for from eight days to two weeks, during which time he had refused all nourishment and had rallied from the condition quite suddenly, coming back to full consciousness and getting out of bed in the course of an hour.

The patient died on October 3rd, without ever having regained full consciousness. Just before his death he went through another mild convulsive seizure.

Laboratory examinations showed the following: Hemoglobin, 56 per cent; round blood cell count, 4,400,000; white blood cell count, 8,800; blood pressure, 110/65; differential count showed a slight preponderance of lymphocytes, mostly small, otherwise normal. Gastric analysis showed no

Fig. 6—Photomicrograph of metastatic alveolar round-cell sarcoma of lung; primary in right foot. Case II.

free hydrochloric acid in the fasting specimen with a total acidity of 33 per cent. Test meal was drawn 45 minutes after ingestion and showed free hydrochloric acid, 26 per cent; total acid, 58 per cent. Stool was negative for blood. Spinal fluid negative. Urine negative.

Clinical diagnosis was gastric ulcer.

X-Ray Examination: Erect position. No previous meal. Suspension given. Drops through a large secretion zone. Peristalsis begins immediately. Stomach freely movable. Outer border of a lighter density. No filling of the cap. Peristalsis moves entirely to the antral end of the stomach, which is blunt. Peristalsis deep.

Dorsal position: Immense gastric shadow. Peristaltic waves almost sever the gastric shadows. Two wave type. Dimpled antrum. Small amount of barium seen in the second portion of duodenum but no cap noted, plate. *Fluoroscopic examination* at 24 hours shows a large gastric residue. Peristalsis cuts deep. No cap seen. Large amount of gas throughout the large bowel. Some in descending colon. Stomach shadow is at the level of the pubis. *Plate at 9 o'clock:* Large gastric shadow. Deep peristaltic wave. No cap. *Plate at 3 o'clock:* Large gastric residue. Some barium in the small bowel. *Plate at 24 hours:* Immense gastric shadow. Low in the pelvis. Some barium in the colon.

Diagnosis: Gastric ulcer with obstruction.

Pathological Report: Autopsy 1352. A-33-AA. R. E. H., age 26. Died 10-3-22, 7:45 P. M. Autopsy 10-4-22, at 10:00 A. M.

Clinical Diagnosis: Gastric ulcer.

Pathological Diagnosis: Multiple acute abscesses of lung. Purulent emboli in pulmonary vessels. Metastatic pneumonia. Diffuse acute purulent bronchitis. Aspiration pneumonia(?). Congestion, edema, multiple hemorrhages and hemorrhagic infarctions of lungs. Chronic parenchymatous degenerative nephritis with marked calcification. Toxemia (Sub-nitrate of bismuth or mercurial poisoning ?). Chronic leptomeningitis. Early syphilitic aortitis(?). Localized renal, coronary and central sclerosis. Total aspermatogenesis. Persistent hyperplastic thymus. Asthenic constitution. Heterotopia of left kidney with anomalous vascular supply. Spastic paraplegia of stomach with extreme dilatation. Spasmophile constitution (Tetany). Small healed erosion in prepyloric region. Chronic obliterative appendicitis. Atrophy, passive congestion and parenchymatous degeneration of all organs.

Pathology of Abdomen: No gas or fluid in peritoneal cavity. The omentum was almost devoid of fat; it was free except for a few small adhesions to the abdominal wall in the left upper quadrant. It was gathered up for the greater part along the greater curvature of the stomach. Diaphragm high, fourth rib on the right; fourth interspace on the left. Peritoneum moist-shining throughout. The stomach was enormously dilated, reaching to the pubis. The colon seemed unusually long; the transverse colon was thrown into a V-shape, the point of the V being upward, behind and beneath the lesser curvature of the stomach. Both splenic and hepatic flexures thrown into large folds. It was only moderately distended with gas, and its lumen was not unusually enlarged. The appendix was retrocecal, bound down by adhesions; it measured 6 cm. in length. The small intestine contained a small amount of grayish, yellowish-brown fluid. Its wall showed marked congestion. The bile passages were patent. No pathologic condition of gall bladder. The pylorus was unusually small, requiring a marked degree of pressure to force the tip of the little finger through. The tightness of the pyloric ring was not due to muscular hypertrophy and induration of the ring, but either to an actual developmental disturbance or a persistent tonicity. The greatly dilated stomach cavity contained a large quantity of gas and bile-stained fluid in which numerous grape-seeds and corn kernels were suspended. The stomach wall was thinner than normal, but not proportionate to the degree of dilation. The mucosa itself appeared thin and grayish, somewhat congested towards the cardiac end. The cardia was dilated, taking two fingers easily. No ulcer or erosion in the mucosa of the stomach in any portion. About 2 cm. above the pyloric ring there was present in the mucosa a small area of induration beneath the mucosa, probably a healed erosion or small ulcer.

The microscopical examination of the stomach wall showed a diffuse chronic catarrhal gastritis of moderate degree. The area of induration in the prepyloric space showed no recent process. The mucosa was intact over an area of slight fibrosis in the sub-mucosa; a healed small ulcer or erosion, most probably a small healed traumatic lesion due to use of stomach tube.

This case presents a complicated pathology. The patient was a man of inferior constitution, as shown by his persistent thymus, asthenic build, anomaly of left kidney and pylorus. He had a latent syphilis, as shown by the focal chronic leptomeningitis and

Fig. 7—Case III. Plate immediately after barium meal. Hyperperistalsis. No filling of cap.

Fig. 8—Case III. Six hour plate. Large residue. No outline of cap.

Fig. 9—Case III. Twenty-four hour plate. Large amount of fluid in stomach with considerable barium still retained.

aortitis of syphilitic type. He had also a chronic recurrent obliterative appendicitis. Acquiring the habit of stomach-washing, he increased his stomach dilatation to the point of temporary closures of the pyloric ring through spastic increase in tonicity of the pyloric ring or kinking of the pylorus due to downward pull of the greatly distended stomach. Associated with this condition he had had well-defined attacks of tetany. In this respect his condition is best described as showing the characteristics of the spasmophile constitution. He had also a marked chronic toxic degenerative nephritis of the type usually produced by mercurial poisoning, but also claimed by some writers to occur in poisoning with bismuth-subnitrate. The possibility of the latter may be assumed in connection with his stomach condition, although toxicologists are not agreed as to the toxic nature of subnitrate of bismuth. The immediate cause of death is to be found in the wide-spread pulmonary lesions. These are best explained as secondary purulent processes dependent upon a primary localized area of aspiration pneumonia with abscess formation.

The autopsy findings do not confirm the clinical and roentgenological diagnoses of gastric ulcer. There was no active ulcer or erosion; the small area of sub-mucosal fibrosis in the prepyloric space represented a small healed lesion of no bearing upon the present condition. The pyloric obstruction can be satisfactorily explained as due to a spastic closure of the pylorus associated with the downward pull of the dilated stomach. This condition resembles that seen in post-operative gastric paraplegia with tetany.

CASE IV.—*H. B. S.* Surgery and *Internal Medicine.*

Clinical History: This patient is 67 years of age, an American, bachelor. Chief complaint is weakness, lack of appetite and a pain in the epigastric region. His trouble dates back only three months, when he began to be seriously annoyed by a pain in the stomach. It was present day and night for a time and then for a few weeks eased up considerably. It recurred, worse than ever, and has been present continuously ever since and the patient has been in bed for the last four or five days before his entrance to the hospital. His appetite was unimpaired up to one week ago. According to his statement however, he has continued to lose weight slowly but surely for the past three months. Weakness was an early symptom. He vomited but four times in the past three months, although on every occasion he has vomited typical coffee ground material and in such amounts that retention is quite evident. His bowels have been constipated, not tarry, and no fresh blood observed.

Ward Notes: This patient was in an extreme state of emaciation on his entrance and examination readily showed the patient to be suffering from a pyloric obstruction, as he had a tremendously distended stomach, readily observable, with marked peristaltic waves passing from left to right. The patient gave ample demonstration of the clinical diagnosis on his second day after entrance, when he vomited at least three quarts of black, coffee-ground material and in this material was food which the patient recognized as having been eaten two or three days previously. He was considered to be in extremis with but one chance which the surgeons consented to give him. Operation was done, a rapid gastro-enterostomy, but the patient survived only twelve hours.

X-Ray Examination: Erect position. Acacia mixture given. The patient had some difficulty in swallowing, but we could note no evidence of a lesion in the esophagus. The stomach is enormous, apparently filled with fluid as the mixture gets to the fluid and descends to the most dependent portion of stomach, just above the pubis. The patient was too weak to stand up for the remainder of the examination. No definite defect was noted at this time.

The examination in the recumbent position was not satisfactory. Patient vomited a large amount of coffee-grounds material. Stomach was faintly outlined, enormous. Apparently a large obstruction at the antral end. Plate.

Fig. 10—Case III. Gross appearances of enormously dilated stomach. Pylorus and duodenum at middle left.

Twenty-four hour fluoroscopic examination. Enormous gastric residue, apparently due to an almost complete retention in the stomach; only irregular shadows in the remainder of the bowel. Plate.

Review of the fluoroscopic examination and study of the plates shows an enormous aperistaltic stomach with a total obstruction. There seems to be no evidence of barium shadows in the upper or lower bowel. We think this amount of retention is probably due to an obstructive lesion which is apparently a malignant lesion, not showing as a gastric defect.

Pathological Report: Autopsy 1363. A-44-AA. H. B. S., male, age 67. Died 10-27-22 at 2:00 A. M. Autopsy 10-27-22 at 9:30 A. M.

Clinical Diagnosis: Cancer of pylorus with complete obstruction.

Roentgenological Diagnosis: Obstructive lesion of pylorus, apparently

Fig. 11—Case IV. Plate immediately after barium meal. No antral defect. Apparently complete obstruction.

Fig. 12—Case IV. Twenty-four hour plate shows large gastric retention with practically no barium found in the intestines.

a malignant lesion, not showing as a gastric defect.

Pathological Diagnosis: Primary adenocarcinoma of pancreas; marked chronic interstitial pancreatitis; dilatation of pancreatic ducts; diffuse carcinomatous infiltration of pancreas, scirrhous in type. Multiple metastases in liver, retroperitoneal nodes, omentum and retroperitoneal tissues. Death postoperative (gastro-enterostomy). Marked marasmus. Old syphilis (myocarditis, aortitis, orchitis, pancreatitis). Multiple anemic infarcts of kidneys. Old tubercles of bronchial nodes and lungs, still active. Acute miliary tuberculosis of liver. Chronic adhesive pleuritis. Chronic perisplenitis. Chronic prostatitis and cystitis. Recent thrombosis of prostatic plexus extending into right iliac vein and vena cava. Atrophy and passive congestion of all organs. Emphysema. Healed scar in right upper arm. Terminal lobular pneumonia.

Pathology of Stomach: Just behind the pyloric ring there was a firm hard mass about the size of an apple, representing the head of the pancreas, which kinked the pylorus and first portion of the duodenum anteriorly. On opening the duodenum and passing the index finger towards the mass, the pylorus was found to be patent, but the finger could be pushed through it only by bringing it sharply anteriorly and then bending it slightly posteriorly. This pyloric obstruction was due wholly to the adhesion externally and pull of the enlarged head of the pancreas. Over this mass the mucosa of the duodenum just below the pyloric ring showed a shallow funnel-shaped depression with slight puckering, suggesting an old healed ulcer. The mucosa of the stomach and duodenum was everywhere intact. The first portion of the jejunum was securely sutured to the anterior portion of the stomach wall near the pylorus. The surgical area showed no leakage, hemorrhage or evidence of infection. The stomach was almost completely filled with a dark grayish mud-like fluid of blood and barium. Section of the pancreas showed head and body of the gland to be wholly replaced by a scirrhous neoplasm, while the tail showed numerous areas of firm yellowish neoplasm with a very small amount of pancreatic tissue remaining. The main pancreatic duct was open, dilated, and filled with a glistening cloudy fluid. The biliary passages were patent; and there was no jaundice, a point of importance with relation to the differential diagnosis of carcinoma of the pancreas.

The microscopical examination showed the greater part of the pancreas to be replaced by a scirrhous adenocarcinoma. The acini were practically absent; the dilated ducts and islands of Langerhans preserved. At the point of adhesion between the enlarged head and the duodenum the carcinoma infiltrated the subserosa and outer muscle-coats of the adherent portions of the duodenum and pyloric ring. In no place was the mucosa infiltrated.

The pathological findings, therefore, confirm the x-ray diagnosis of "pyloric obstruction without defect of the stomach wall, probably of malignant origin."

CASE V.—T. T., age 16 months. *Pediatrics and Otology.*

Clinical History: Admitted to the hospital November 8, 1922. There was a history of aspiration of a peanut seven weeks before admittance followed by violent choking and coughing. Cough has persisted. There have been periods of remission. Just before entrance patient seemed much worse with more difficulty in respiration and frequent attacks of choking. Physical examination showed the patient to be acutely ill. Picture was one of sepsis with sunken eyes, pallor, prostration, and a temperature of 103 Fahrenheit. Patient showed almost continuous cough. Over the right back were loud rales with some asthmatic breathing, no crepitant rales. Left chest showed a few rales. Diagnosis on admission was bronchopneumonia with foreign body in the right bronchus. He seemed fairly comfortable during the afternoon and evening of the day of admission, until suddenly early the next morning he showed a severe coughing spell with severe dyspnea. Artificial respiration and oxygen were used without avail.

X-Ray Examination: Stereoscopic plates of the chest made in the antero-posterior direction. These plates show an uneven illumination of the lung fields, the upper right lung field being quite dark, indicating diminished density. The middle lung field shows mild opacities and there is a decided opacity in the lower right lung field. Careful survey of the right lung field convinces us that there is a beginning bronchopneumonia of the upper lobe, a fairly well established bronchopneumonia in the middle lobe and a very advanced bronchopneumonia in the lower lobe. The left lung field shows good transparency of the upper lobe. The lower lobe shows an opacity which is not quite similar to the bronchopneumonia on the other side. It may possibly be due to slight rotation and the superimposed shadow of the heart. From the appearance of the right lung field we would think that aside from the evidence of infection in the three lobes that there was a non-opaque foreign body in the right bronchus.

Pathological Report: Autopsy 1371. A-52-AA. T. T., aged 16 months. Died 11-9-22 at 5:00 A. M. Autopsy 11-9-22 at 10:00 A. M.

Clinical Diagnosis: Right bronchopneumonia with foreign body (Pediatrics). Bilateral pneumonia, foreign body. Lung abscess on right (Otology). Early bronchopneumonia of right upper lobe, well-established bronchopneumonia in middle lobe and advanced bronchopneumonia in lower

Fig. 13—Case IV. Gross appearances of dilated stomach. At A an incision through the intact stomach wall shows an incision into the dense carcinoma mass in the head of the pancreas to which the pyloric and duodenal obstruction were due.

Fig. 14—Photomicrograph of scirrhous carcinoma of pancreas. Case IV.

Fig. 15—Case V. Anteroposterior plate of chest. Note over-distension of right lung, with slight opacity in upper lobe, mild opacity in middle lobe, and marked opacity in right lower lobe. Increased density in lower left.

lobe. Non-opaque foreign body in the right bronchus (Roentgenology).

Pathological Diagnosis: Aspiration of peanut, lodging in right main bronchus just beyond the bifurcation. Diffuse right-sided purulent bronchitis, bronchiectasis and bronchiectatic abscesses containing young colonies of actinomyces. Right-sided pleuritis. Flooding of left bronchial tree with pus. Death from suffocation. Partial atelectasis of left lung. Status thymico-lymphaticus. Hypoplasia of adrenals. Acute passive congestion and parenchymatous degeneration of all organs. Meckel's diverticulum.

Pathology of Respiratory Tract: No foreign body in larynx or trachea. They contained a small amount of slightly blood-tinged muco-purulent exudate. As the bifurcation was reached the trachea and both main bronchi were found filled with a tenacious purulent exudate. No foreign body in left bronchus. In the right one about one-half to two-thirds of the split half of a peanut was found lodged against the bronchial mucosa. The peanut itself was covered with a thick pus; it was soft and easily fragmented. It lay in a shallow area of ulceration having a definitely raised border, situated nearer to the main bifurcation than to the first branch of the right bronchus. The entire right bronchial tree was filled with thick pus. The right lung measured 14 by 7 by 4 cm. Much larger than the left lung. Pleural adhesions over the base and between the lobes. The bronchi of all three lobes were dilated and filled with pus. The cut surfaces of all three lobes showed elevated, firm, yellowish areas with purulent centers. The picture was that of a diffuse purulent bronchopneumonia with multiple abscesses. The left lung showed complete atelectasis of about one-third of the upper lobe. The large bronchi were filled with pus; the smaller ones were empty. No pneumonic areas were found. The pus in the larger left bronchi had evidently come from the right side, causing acute suffocation.

The microscopical examination of the right lung showed a sub-acute purulent lobular bronchopneumonia with multiple bronchiectases and bronchiectatic abscesses. In many of these abscesses small colonies of a ray fungus with hyaline clubs at the periphery of the colony were found—young actinomyces colonies. These were found especially in the older, larger bronchiectatic abscesses in the lower lobe. About these abscesses the lung tissue showed diffuse inflammation, congestion, edema, fibroblastic proliferation and thickening of the alveolar walls. On the left side the large bronchi were filled with pus without involvement of the bronchial walls. This lung showed only localized atelectasis, patches of acute emphysema, general congestion and edema.

The pathologic findings support the x-ray diagnosis.

CASE VI.—Mrs. R., age 53. *Clinics of Surgery and Internal Medicine.*

Clinical History: Entered the hospital October 31st, 1922. Principal complaint on entrance was weakness, projectile vomiting without nausea, frequency of urination, and loss of weight. Was well up to July 20, 1922, when she noted a marked sleepiness with profuse perspiration. She passed marked cloudy urine and complained of projectile vomiting. Lost sixty pounds in weight. There was also constipation, thirst and polyuria. She has complained of difficulty in the vision of the right eye. She had scarlet fever, dropsy at the age of 3 years, "ague" at the age of 10, painful kidney trouble eight years ago, operated upon for "gall stones" eight years ago and appendectomy was done at the same time. She complained of some shortness of breath with some coughing. Menopause took place at 44. She shows jerking and twitching of the muscles with numbness of the fingers at times. No difficulty in walking. She had a 2 plus Wassermann on one examination and a plus-negative on a second examination. Spinal fluid was negative. Examination shows a large ventral hernia with a large mass in the lower abdomen. Eye examination showed marked neuroretinitis with angiosclerotic changes. There is a large amount of pus and albumin in the urine. Provisional diagnosis was pyo-nephrosis, acromegaly, possible lues, duodenal ulcer. Cystoscopic examination showed thick stringy pus coming from the left ureter. Her basal metabolism was plus 11. The patient's general condition in connection with the tremendous size of the pyonephrosis rendered surgical intervention extremely hazardous. She died suddenly on November 19th, 1922.

X-Ray Examination: Stereoscopic plates of the wrist showing the lower end of the radius and ulna, show no definite enlargement. The bone changes here do not correspond to an acromegaly. The plates of the fingers show definite enlargement of the bone which is a frequent accompaniment of acromegaly.

Stereoscopic plates of the stella turcica on this same case show moderate sized sella but with a distinct bony roof, constituting the so-called ring type of sella.

Stereoscopic plates of the left side of the skull show normal outline of the skull, normal development of the fron-

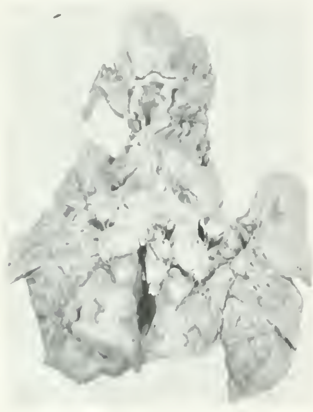

Fig. 16.—Case V. Gross appearance of right lung. Diffuse purulent bronchopneumonia with multiple abscesses. Microscopical examination showed colonies of actinomyces in abscesses in lower lobe.

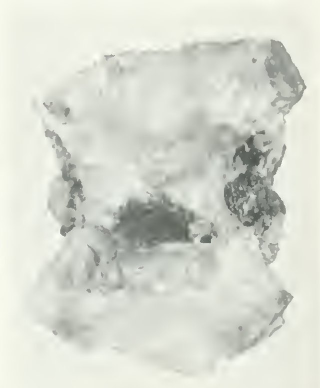

Fig. 17.—Case VI. Plate of sella turcica shows completely roofed sella constituting the so-called ring sella. Evidence of bone proliferation posterior to the clinoidal processes.

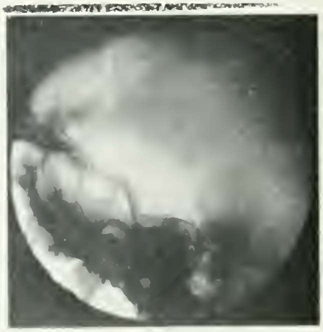

Fig. 18.—Case VI. Ring sella. Base of skull shows irregular exostoses and spur-like processes posteriorly, the large one on the right side posteriorly showing well.

tal sinuses and grooves of the meningeal vessels. The sella is distinctly shown to be of the ring type. Increase in the bone density of the section back of the posterior clinoidal processes. The appearance is not suggestive of an actual acromegalic condition.

Pathological Report: Autopsy 1383. A-64-AA. Mrs. A. R., age 53. Died 11-20-22 at 10:00 A. M. Autopsy 11-20-22, at 12:15 P. M.

Clinical Diagnosis: Left pyonephrosis. Acromegaly.

Roentgenological Diagnosis: Ring type of sella turcica. Moderate sized sella. Enlargement of phalanges. No positive signs of acromegaly.

Pathological Diagnosis: Acute fibrino-purulent peritonitis. Multiple duodenal peptic ulcers with perforation of one. Advanced chronic pyonephrosis on left side with ureteral calculus blocking ureter. Chronic cystitis. Marked fatty infiltration of liver. Fatty infiltration and fatty degenerative infiltration of heart. Sclerosis of endocardium. Ventral hernia with incarceration of omentum. Ring shaped sella. Cholesteatoma of pituitary. Dyspituitarism. Adenomatous goiter. Hypothyroidism. Obesity. Atrophy of frontal convolutions. Chronic leptomeningitis with congestion and edema. Osteophytes in dura mater. Hemosiderosis of spleen. Atherosclerosis of aorta with calcification of media. Mœnckeberg's calcification of medium sized arteries. Congestion and edema of lungs. Old healed tubercle in right lung. Right-sided adhesive pleuritis. Chronic fibroid salpingitis. Prolapse of right tube. Old scar in posterior cul de sac. Chronic pelvic peritonitis.

This case presents a great variety of pathological conditions that may be brought into the following groups: *First—Constitutional.* An endocrinal case, as shown by conditions found in the cranium, enlargement of sella, ring sella, formation of osteophytes in dura, basal exostoses, hypertrophy, fibrosis and multiple cholesteatomas of pituitary, hypothyroidism and obesity. Facies stolid, coarse, suggesting hypothyroidism. Low and disturbed mentality as shown by cerebral atrophy. The endocrinal condition is perhaps best interpreted as an early frustrate acromegaly, passing into the adiposo-genitalis form of dyspituitarism. *Second—Gastro-intestinal.* The immediate cause of death was a generalized acute-fibrino-purulent peritonitis extending to diaphragmatic pleura, resulting from perforation of a chronic peptic duodenal ulcer. Ventral hernia with omental incarceration. *Third—Genito-urinary.* Chronic cystitis. Left-sided chronic pyonephrosis with blocking of left ureter by calculus. Chronic fibroid salpingitis. Prolapse of right tube. Old scar in posterior cul de sac. *Fourth*—Premature atherosclerosis and calcification of arteries.

Of these conditions the only ones recognized by roentgenological examination were the ring-shaped sella, the increased density of the neighboring bone, the spur-like exostosis posterior to the sella and the enlargement of the terminal phalanges which was not considered in itself diagnostic of acromegaly. The pathological diagnosis of an early acromegaly rests upon the enlargement of the sella and pituitary, the atypical osteogenesis about the sella, the exostoses of the base of the skull, the formation of characteristic osteophytes in the dura mater. The hypophysis was about twice the normal size. The anterior lobe was about evenly divided into two portions, one composed of eosinophile cells, the other of basophile. The chief cells were reduced in number and showed unusual vacuolation. The capsule was thickened. The intermediate lobe showed very little colloid in small spaces, with greatly increased stroma. Attached to the intermediate lobe was a small cyst filled with laminated flattened cells (cholesteatoma). In the capsule of the posterior portion there were a number of small concentric masses of flattened cells (cholesteatoma pearls). The combination of hypertrophy of anterior lobe, atrophy of intermediate lobe and presence of multiple cholesteatomas form the basis for the pathological diagnosis of an early acromegaly (hyperpituitarism) passing into a condition of hypopituitarism, as the result of lowered function due to atrophy and fibrosis resulting from the pressure of the developing cholesteatomas.

The x-ray study of this case was limited to the bones of head and hands following the suggested clinical diagnosis of acromegaly. The patient, however, died of a peritonitis following the perforation of a duodenal ulcer, and had also a renal calculus obstructing the left ureter. X-ray study of these regions would have thrown additional light upon the nature of the conditions to be dealt with, and would have materially altered the clinical conception and procedures. This may be taken as an argument for the x-ray investigation of the body as a whole in all doubtful cases, instead, as is the rule, of confining that investigation to the region suggested by the clinician. The roentgenologist would then have an opportunity for more independent objective study of the case.

Conclusion

In conclusion, we believe that such correlative studies of x-ray plates and autopsy data are essential to the scientific advancement of roentgenologic interpretation. The x-ray plate is an objective fact; the interpretation is an intellectual process based upon knowledge and experience. The plate tells no lies, but the interpretation might do so.

Diathermy, Its Field and Application

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PROFESSOR ZIMMERMAN, of Paris, has defined diathermy as "a form of thermo-therapy which utilizes electrical energy for the production of thermal effects in the depths of the tissues." Synonyms are: "endothermy", "thermo-penetration", "transthermy". Two forms of diathermy are recognized: "electrocoagulation", which is a process by which tissues are heated beyond the physiological limit compatible with their life; and "medical diathermy," wherein tissues are heated only within physiological limits, i. e., without their resulting death. This paper will deal only with the latter phase, and the term "diathermy," unless otherwise specified, will refer to medical diathermy only.

*—Read Before the Joint Meeting of the Interstate Society of Radiology and Physiotherapy, and the Nebraska Radiological Society, Lincoln, Nebraska, May 14, 1923.

It is a well-known fact that any electrical current when subjected to resistance in its circuit produces heat. The greater the resistance, the greater the resulting heat. The body tissues offer a high resistance to the passage of an electrical current through them. Upon this principle diathermy is based. It is impossible, however, to use any kind of current for diathermy. A continuous, or galvanic, current cannot be utilized because of the pain produced by its application and because of the marked effects which take place at the points of application. A faradic current has the same drawbacks, and in addition causes violent muscular contractions.

In 1890 d'Arsonval, in repeating and elaborating the experiments of Ward, showed that if a current be reversed over five thousand times a second, the muscular contractions decrease in proportion to the increase in periodicity. Tesla, in 1891, utilized the rapid oscillatory discharges from Leyden jars, and passed large currents of high potential through the body without any painful or harmful effects. In the same year d'Arsonval passed three amperes through his own body without any sensation except that of heat. In 1896 he passed five hundred milliamperes through his patients, who noted distinct heating effects. In 1907 Nagelschmidt, at Dresden, demonstrated the "heating through" of tissues by high frequency currents and suggested their use in the treatment of diseases of the circulation and the joints.

The requisites for an effective diathermic current are as follows: The voltage must be high (from 10,000 to 50,000), the amperage low (from 100 to 3,000 ma.), and the oscillations very rapid (generally about 200, 000 per second). Furthermore, the electrodes in contact with the body must be large enough to deliver the current to the tissues without undue heating, and they must be in good contact with the surface of the body.

Some of the more important effects of diathermy are:

1. Production of internal heat.
2. Stimulation of vasomotor nerves.
3. Stimulation of cellular activity and metabolism.
4. Marked analgesic properties.

Because of the shortness of this paper, these aspects will be but touched upon. To cover the ground thoroughly, considerable time would be required. Hence, a few remarks on each ot these points will be offered, as a guide to further study.

The body tissues react to injury and infection by inflammation. In the case of injury without infection, inflammation increases metabolism and cellular activity in the injured region, thereby hastening repair. In the case of infection, inflammation serves several purposes. It increases metabolism; with increased metabolism comes increased temperature; with increased metabolism and temperature comes increased cellular activity. Most pathogenic organisms thrive best at body temperature, which is their optimum. As the temperature of the medium surrounding the bacteria is raised their vitality is lowered, their aggressiveness is less and their rate of propagation is retarded. Hence they are more susceptible to the defensive powers of the body. Vital processes are chemical reactions or the result of them. Heat increases the rapidity of chemical reactions in the body cells. Within certain limits, with increased temperature, there is increased metabolism; with increased metabolism there is an increase in the intensity of the natural body defenses against invading infection and also greater rapidity of repair in injured tissues. Crile states: "In what way may heat exert its beneficial influence? Grant the premise that the natural defense of the organism against infection is made through the agency of phagocytosis and the chemical antagonism of the blood plasma, it becomes evident that in either case the defense is chemical. The fact that the defense is chemical gives at once a clue to the mechanism by which heat assists the defense against bacteria. It is probably because with the rise of each degree of temperature in any system, inorganic or biologic, the chemical activity is increased ten per cent, and the electric conductance two and one-half per cent. The increased chemical activity increases the chemical defense; the increased electrical conductance increases the metabolism. Therefore, we may suppose that heat accelerates the chemical defense as far as it involves chemical defense of the blood plasma, and that the heat aids also by increasing the total amount of blood in the inflamed part, thereby increasing the number of phagocytes. Morever, heat assuages pain".

Fever is the natural method of increasing the heat of the body in times of stress. Let fever be produced how it will, by the body, it accomplishes these results:

1. Retards the propagation of bacteria.
2. Lowers their aggressiveness.
3. Lowers their resistance toward body defenses.
4. Stimulates body metabolism.
5. Stimulates body defenses thereby.

Diathermy is a "localized fever". This localized fever produces results which are largely confined to the area of application. The effects on bacteria and tissues are similar to those produced by natural fever. For localized conditions diathermy has several advantages over naturally produced fever: to-wit: it can be regulated as to area, height of temperature, and length of the time of application. With increased metabolism in a small area of the body, the tissues as a whole are not rapidly oxidized and the general resistance lowered as in natural fever of the general type. It is a fact, however, that the temperature of the body as a whole can be raised from one-half to four degrees by the lengthy application of diathermy. Saberton states: "The artificial general pyrexia resulting from a diathermy treatment differs from ordinary pyrexia in that it is not produced by toxins circulating in the blood. After cessation of the treatment, the heat regulating mechanism quickly eliminates the excess of heat, and the temperature returns to normal. Dr. Albert C. Geyser points out that inflammation "is a physiological process, and is nature's attempt to cure, and that the principle factor in inflammation is the production of heat. Diathermy currents produce physiological heat within the tissues, and thereby assist nature to react and cure disease. If used within physiological limits, these currents are vitalizing and constructive."

In speaking of the effect of diathermy on the vasomotor system, F. de Kraft, in a Report of the Committee on High Frequency Currents, says: "the first effect of the great rapidity of the succeeding groups of oscillations is an intense heating of the surface of the body and of the blood. This, in turn, stimulates the great system of vasomotor nerves, resulting in peripheral dilatation of the blood vessels, and, at the same time, in the stimulation of the sweat-glands. It would appear that the sympathetic nervous system is stimulated in a most profound manner." De Kraft is further quoted by Lewis Jones: "Venous congestion, wherever present, is relieved, because of the marked activity of the circulation. Anemia of the splanchnic area ensues in the prolonged application of diathermy over large areas. When the action of the diathermic current has subsided, and the blood stream has returned to its normal channels, freshly oxygenated blood enters in greater abundance into the previously anemic and venously congested areas. The parts are placed in a better state of defense against the invasion of toxins and bacterial colonies." The stimulation of the vasomotor mechanism is not so much a direct effect by the current, as a secondary one resulting from the heating of the tissues.

Heat assuages pain. The application of a hot water bottle to an earache, pleuritic area, or inflamed appendix is an example familiar to all, as is the use of hot fomentations in the relief of pain in acute rheumatic fever. At times external heat, be it dry, moist or radiant, gives relief when applied directly to or near the painful area. At times more marked relief is obtained by applying it over the reflex point.

External heat does not penetrate the tissues to any great extent; the blood stream quickly equalizes the difference in temperature between the point of contact of heat and the deeper tissues.

The action of diathermic heat is much more effective. The heat from this source is *endothermic*,—it is generated in the tissues themselves by their resistance to the diathermic current which is passing through them. The temperature is as high midway between the electrodes as directly beneath them. The operator is not confronted by the necessity of heating the surface of the body beyond the point of comfort to obtain a slight heating effect for a short distance beneath it, nor is he forced to prolong the application of warmth for one-half to three-quarters of an hour before effect is obtained. When diathermy is used, less than two minutes elapse before the sensation of heat is felt in the deep tissues, before it is perceived by the skin. This "internal heat" may be brought to any point desired and maintained there as long as desired. It may be "focused" in any direction, perpendicularly, obliquely or horizontally by proper arrangement of the electrodes. Where there is a relatively large amount of bone embedded in the tissues treated, diathermy has another advantage, for while the bony and other dense structures heat very slowly and require long application of a mild degree of warmth, when once heated through they dissipate their heat to the surrounding tissues very slowly, often requiring several hours to return to the temperature of the body. In this case the effect is quite prolonged and mild.

The indications for the application of diathermy are many. To go into the conditions which have been very markedly benefited by it would consume a vastly greater amount of time and space than is allotted this paper. Hence, they will be briefly dealt with. In a few words, the indications for the use of diathermy are as follows:

1. Wherever heat is necessary.
2. To increase local resistance.
3. To stimulate local metabolism and reparative process.
4. To lower bacterial aggressiveness and retard bacterial propagation.
5. To stimulate vasomotor mechanism.
6. To relieve venous congestion.
7. To relieve pain.
8. To stimulate cells and individual glands.

A few of the conditions in which diathermy has been particularly effective may be mentioned. Lobar pneumonia reacts in a startling way to diathermy if treatment is commenced in the early stages. If given in the state of engorgement, hepatization is prevented, and the disease goes on to rapid resolution. This mode of treating pneumonia was developed by Dr. Harry E. Stewart, of Yale, and has since been used by a number of others with great success. Applications are made twice daily. The electrodes are placed over the affected lobe or lobes, anteriorly and posteriorly, with a graduated dosage of 500 to 2,500 ma. from fifteen to twenty minutes duration. Usually six to eight treatments suffice. After hepatization has taken place, although the stage of resolution is hastened, the course of the disease is not much shortened.

A high degree of success has been reported in the diathermic treatment of tubrculous kidneys. Cases carefully diagnosed by cystoscopic examination, and ureteral catheterization, and showing tubercle bacilli in the urine were entirely relieved of symptoms, and the patients gained rapidly in weight. The initial dosage was 500 ma. for twenty to thirty minutes, which was later increased to 1,000 ma. for ten minutes. The active electrodes were placed over the kidney region, with the indifferent electrode over the abdomen.

Pulmonary tuberculosis reacts rapidly to diathermy when the disease has not progressed far. In the incipient stages relief of symptoms is very rapid. If the temperature is over 100 F., diathermy should be used very cautiously. During the first few applications of diathermy there is a marked increase in the symptoms, the cough becomes more pronounced, the expectoration more profuse, the temperature higher, and symptoms of toxicity increased. Later these subside rapidly. This is a natural sequence, and, if the technique is correct and the patient is watched closely, no fear need be experienced. One of the modern authorities on diathermy, who has had vast experience with it, states that he has never seen a case that was not benefited by diathermy, when the technique was correct.

Bone and joint affections react well to this mode of treatment. Encouraging reports on tubercular processes in bones and joints are numerous. They state that healing and resolution take place rapidly as a result of its employment. In cases of ankylosis the tissues are softened and permit gradual restoration of motion, where the condition has not been of such long standing that the ankylosing tissues are infiltrated with bone itself.

After treatment by diathermy myocarditis often shows marked improvement on functional test. The power of sustaining an additional load is markedly increased after eight or ten applications of 500 to 1,000 ma. for ten to twenty minutes. The active electrode is placed over the myocardium and the indifferent electrode over the interscapular region.

The diathermic treatment of cancer is still in the experimental stage, but some promising results seem to have been demonstrated. Its use does not jeapordize the patient's safety or preclude the use of other measures. The New York State Cancer Laboratory states that all cancer cells die when subjected to a temperature of 116.6 F. for thirty minutes. Erlich determined that cancer tissue is no longer viable on transplantation after being maintained at 111.2 F. for thirty minutes. Dr. Albert C. Geyser states that: "From practical experience it has been shown that, when the entire malignant growth has been subjected to an increase of three degrees of temperature for sixty minutes daily, the physiology is markedly interfered with. Cachexia is prevented or removed; the tumor mass undergoes a retrograde metamorphosis, individual nodules soften; discharges lessen and lose their offensive odor." Neiswanger states: "A malignant growth is more dense and resisting than surrounding structures, with low vitality and a less direct, active circulation, and so is peculiarly calculated to accumulate and store heat." The writer offers no opinion on the matter, as his experience has not embraced this phase of diathermy.

Application

In the application of diathermy, the following factors must be considered:

1. The nature of the process to be treated.
2. The area of the process.
3. Its depth in the tissues.
4. The nature of the intervening tissues.
5. The result to be accomplished.

All these factors are of great importance, and unless cognizance is taken of them all, the maximum effect will not be obtained, and perhaps more damage than benefit will result.

The electrodes which supply the current must be good conductors, they should make a good contact with the body and they should be of such material as to allow moulding to the contour of the body where necessary. There are many kinds. The ones most used today are of block tin. Contact with block tin electrodes is made in one of two ways: a layer of gauze saturated with water or salt solution is placed between them and the skin; or the electrode and skin are well moistened with thick soap lather and the pad immediately applied. Another form is a moist composition pad, backed by a rubber plate. Where the surface of contact is very uneven, as about the shoulder, etc., an electrode of German silver mesh is used. This mesh is covered with thick soap lather before applying, and then weighted

down with a soft sandbag. Great care should be taken to see that contact is even throughout, and that the electrodes remain uniformly moist, as severe burns might result if the current were allowed to concentrate in a small area.

Electrodes should be placed so that the current traverses the shortest path through the tissue to be treated. The relative size of the electrodes is very important. When they are of equal size, the heat generated is uniform over both areas, since the current traverses the tissue perpendicularly. If, however, one of the electrodes is smaller, the current is converged thereby, and the current density on the smaller electrod is greater than upon the larger. When the electrodes are of equal size, heating is apparent directly between them, with the highest point at the mathematical center of the crossing lines of force. When they are unequal, the intensity varies inversely as the ratio of the square inch covered, and the point of maximum heat moves, with the center of crossing lines of force, toward the smaller electrode. As the electrode becomes relatively smaller, the heat intensity becomes greater and its maximum approaches closer to the smaller, or "indifferent" electrode, as it is now called. When the intensity of the heat becomes great enough to coagulate the tissues, the process is known as "electrocoagulation". It is not wise to pass over 200 ma. through an active electrode two inches square, nor more than 1,000 ma. through one four inches square.

It will thus be seen that, by the judicious employment of suitable electrodes, the scope of diathermy is greatly widened. The point of greatest intensity of heat may be varied from the surface to a point midway in the part treated, and may be shifted to either side of the midpoint. It may be made uniform throughout or confined to one side. With a bifurcated conducting cord, more than one area may be heated to varying intensities, depending upon the relative sizes of the active electrodes.

In conclusion, let it be said that diathermy has proved to be a therapeutic agent of distinct value in medical practice, and, though it is still in its infancy, it has shown such promise that it behooves us all to develop it still further.

Gastro-Intestinal Foci of Infection in Chronic Deforming Arthritis. Radiological Study of a Series of Cases*

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A SEARCH of contemporary literature dealing with the etiology of chronic deforming arthritis reveals the fact that this condition is not a popular subject for discussion. This is doubtless due to the feeling of helplessness that exists in regard to the therapeusis of this disease. What profits it, we reason, to have discovered the etiology of this condition, when, by the time it presents itself for treatment irreparable damage has already been done? This may all be true. We may not hope to restore to normal the damaged tissues in the particular case under observation. But, if we know the etiology, may we not be instrumental in arresting the progress of the disease, and in preventing the onset of a similar condition in another individual, where that same causative factor is already in operation, with all its potentiality for deformity production? It is with this prophylactic idea in mind that the writer has made a detailed investigation of the series of cases now being reported.

Under the term, chronic deforming arthritis, we include rheumatoid arthritis and osteoarthritis. Specifically excluded from this classification are tuberculous arthritis, syphilitic arthritis, gonorrheal arthritis and gout.

Rheumatoid arthritis is an affection of the synovial membranes and of the soft tissues about the joints, and so is not usually susceptible of demonstration on the x-ray film. It has, as a rule, an acute and stormy onset, occurs in younger subjects, and simultaneously affects many joints, chiefly the smaller ones.

Osteo-arthritis is primarily a disease of the cartilage and bones, tending to the destruction of cartilage, and to the formation of osteophytic outgrowth at joint edges. Hence it gives a characteristic x-ray appearance. It usually has an insidious onset, occurs in older people, and affects a larger joint, as the hip or knee. A favorite site is the vertebral column, where it is known as spondylitis.

*—Read at Annual Meeting of the Radiological Society of North America, Detroit, Dec. 6, 1922.

Fig. 1

Figs. 2 and 3. Mr. P., age 63. Complaint: Epigastric pain, spring and fall. History: Of 15 years duration. Diagnosis: Teeth, tonsils and antra negative. Duodenal ulcer with adhesions. Banded cecum and ascending colon. Spondylitis of lumbar vertebrae.

Chronic deforming arthritis is not by any means a rare condition. In this series a search was made through eight thousand consecutive case reports, with the discovery of two hundred and sixty cases of deforming arthritis.

In the search for etiology in these 260 cases, the writer was surprised to find that only 123 patients had been subjected to a complete gastro-intestinal x-ray examination. Of the cases examined previously to six months ago, only 93 out of a total of 222 had their gastro-intestinal tract explored radiologically. However, during the last six months this proportion has been changed. Out of 38 cases reported during this time, 30 had a complete gastro-intestinal examination.

Why this change in the point of attack, in searching out the cause of this condition? Formerly we were content, unless marked gastro-intestinal symptoms predominated, to localize the arthritic lesion, and to follow the beaten path in the search for foci in the teeth or tonsils or accessory sinuses. But, gradually, as the result of more intensive study of the gastro-intestinal tract, and a more extensive experience of the good results of conservative gastro-intestinal surgery, there has grown up in our mind a profound conviction of the extreme importance of gastro-intestinal lesions in all diseases that may be focal in their origin.

Analysis of findings in 123 cases of chronic deforming arthritis will be shown graphically in three tables.

TABLE 1. FREQUENCY AND CHRONICITY OF SYMPTOMS

1. Frequency:
   - (a) Patients complained of arthritic symptoms in 70 per cent of the cases.

Fig. 4—Mr. P., age 22. Complaint: Pain in left hip and lower spine, worst when turning in bed. Pain in right hypochondrium. History: Attacks of pain in abdomen since childhood. Diagnosis: Teeth, tonsils and antra negative. Chronic cholecystitis. Duodenal adhesions. Bands of ileo-cecal region. Spondylitis, fourth lumbar vertebra.

   Patients with arthritic lesions were free from arthritic symptoms in 29 per cent.
   - (b) Patients complained of gastro-intestinal symptoms in 63 per cent of the cases.
2. Chonicity:
   - (a) Average duration of arthritic symptoms, 17 years.
   - (b) Average duration of gastro-intestinal symptoms:
     Upper abdominal symptoms, 10 years.
     Lower abdominal symptoms, 11 years.

From this table it is evident that in cases of chronic deforming arthritis the gastro-intestinal symptoms occur nearly as frequently as the arthritic symptoms. They also have a marked chronicity, although antedated considerably by the arthritic symptoms.

TABLE 2. LOCATION OF ARTHRITIC LESIONS

1. Rheumatoid arthritis, 14 cases.
2. Osteo-arthritis, 109 cases.
   Distributed as follows:
   - Spondylitis ......40 cases
   - Knee Joint......26 cases
   - Sacro-iliacs .....20 cases
   - Hip Joint.......20 cases
   - Shoulder Joint....20 cases
   - Ankle Joint...... 8 cases
   - Elbow Joint..... 6 cases
   - Wrist Joint...... 6 cases

   (Many cases had more than one joint affection.)

TABLE 3—LOCATION OF LESIONS WHICH MAY BE REGARDED AS FOCI OF INFECTION

1. Gastro-intestinal lesions in 100 cases (81 per cent of all cases):
   - Constricting bands of colon (including terminal ileum) occurred:
     - Ileocecal ......47 times
     - Sigmoid ......10 times
     - Splenic Flexure. 8 times
     - Total.......65 times
   - Duodenal bands or membranes ....22 times
   - Chronic appendicitis 22 times
   - Ileocecal incompetency ....12 times
   - Chronic cholecystitis 17 times
   - Spasticity of colon. 10 times
   - Atonicity and redundancy of colons 5 times
   - Duodenal ulcer.... 3 times
   - Gastric ulcer..... 3 times
2. Teeth, tonsils, and nasal accessory sinuses lesions in 73 cases (60 per cent of all cases), with infection occurring in
   - Teeth ....38 times
   - Tonsils ....42 times
   - Nasal accessory sinuses ....13 times
3. Genito-urinary lesions occurred in 18 cases (15 per cent of all cases).

Leaving out of consideration the lesions which occurred less frequently, it is evident that the important gastro-intestinal tract lesions which occur in chronic deforming arthritis are:

- (1) Constricting bands of the colon (including terminal ileum)....65 cases
- (2) Constricting bands of duodenum ....22 cases
- (3) Chronic appenditicis.22 cases
- (4) Chronic cholecystitis.17 cases

With gastro-intestinal lesions demonstrable in 81 per cent of individuals suffering from chronic deforming arthritis, is it not a fair inference that gastro-intestinal pathology bears some etiological relation to chronic arthritis? What that relation is may be inferred by a process of deduction, but can not be definitely demonstrated except by animal experimentation.

It has been demonstrated experimentally that infective material from the tonsils, or the teeth, or the nasal accessory sinuses, can produce in ani-

Fig. 5—Mr. N., age 65. Complaint: Pain in right lower spine. Pain in right hip and thigh. Pain in neck. History: Pain complaint dates back 25 years. Diagnosis: Marked banding of ileo-cecal region. Osteo-arthritis right hip. Spondylitis, entire lumbar spine—all bridged.

Fig. 6—Mr. D., Age 24. Complaint: Complete rigidity of knees, ankles, hips, elbows. History: Acute onset of joint trouble eight years ago following severe attack of jaundice and dysentery, in bed six months. Progressive involvement of large joints, until now all are ankylosed. Diagnosis: Teeth, tonsils, and antra negative. Duodenal adhesions. Osteo-arthritis, with ankylosis of all large joints.

Fig. 7—Mr. McN., age 50. Complaint: Epigastric pain lasting two or three days and occurring every two or three months. Burning pain in right lumbar region. Pain in back when turning in bed. History: All complaints date back years. Abscessed teeth removed four years ago. Diagnosis: Duodenal ulcer and duodenal adhesions. Chronic appendix. Spondylitis of second and fifth lumbar vertebra.

mals gall-bladder disease or appendicitis, or, by a lengthened process of laboratory culture and subculture, arthritic changes. So that it is generally admitted that infective processes in teeth or tonsils or nasal accessory sinuses are rightly regarded as possible foci for the production of gastro-intestinal and arthritic lesions.

A laudable field of activity for some enterprising bacteriologist would be the attempt to produce arthritic changes in animals by injecting pure cultures of bacteria recovered from not only gall-bladders and appendices, but from under severed duodenal and colonic bands.

In our opinion, based on close observation of a considerable series of cases, the production of chronic arthritis is dependent upon foci in the gastro-intestinal tract even more frequently than upon those found in tonsils, or teeth, or nasal accessory sinuses.

Further we are convinced that where the two classes of lesions coexist in any individual suffering from chronic arthritis, it will be of little value to remove the focus in teeth or tonsils or sinuses, while leaving untouched the gastro-intestinal lesion.

Whether or not one considers that the gastro-intestinal lesion is responsible for any contribution of bacteria to the arthritic process, one must certainly admit that the lesion, related, as it is, to the focus in teeth or tonsils or sinuses, must play a great part in preventing the establishment of immunity against the infecting organism. To expect nature to establish such immunity as will lead to the arrest of the arthritic process, in the presence of an untreated intestinal focus, is certainly contrary to all that we know of the modus operandi of the body defenses.

Fig. 8—Mr. [illegible] Age [illegible] Complaint: Pain [illegible]. History: Dates back years. Diagnosis: Teeth, tonsils and sinuses [illegible]. Banded [illegible] cecum and sigmoid. [illegible] Left knee joint.

Fig. 9—Miss [illegible] Age [illegible] Complaint: Pain in right lumbar region and in right hip joint. Gas in bowels. Belching of gas. History: Pain dates back one year. Abscessed tooth removed one year ago. Diagnosis: Chronic appendix. Banded ileocecal region. Spondylitis of fifth lumbar vertebra.

We presume that all will agree with what has just been stated regarding gastro-intestinal lesions as possible foci of infection, if by gastro-intestinal lesions we mean only chronic gall-bladders and chronic appendices. To thus restrict the term, and so leave out of consideration, in diagnosis and treatment, the constricting bands of the small and large bowels, is, we are convinced, an omission of the gravest moment. In this series these bands were found more than twice as frequently as were chronic gall-bladders and appendices. We regard their investigation and treatment as of the greatest importance. From a somewhat extensive experience in their diagnosis, and in demonstrating their association with the production of symptoms, by observing the relief obtained after their surgical removal, we are convinced that their pathological significance is of the first order.

The subject of intestinal bands and adhesions has given rise to a great deal of controversy. Some claim that they are always pathological and their removal is productive of good. Others hold that they are largely developmental and should not be touched, and that in so far as they are pathological the results of surgical interference are neither beneficial nor permanent.

This whole controversy arises largely out of a confusion of terms. In this, as in most controversies, the opposing schools are not referring to the same thing. The surgeon-optimist of the intestinal tract is thinking of intestinal bands, the surgeon-pessimist is thinking of intestinal adhesions. The two lesions are hopelessly confused in the literature, and yet they are conditions which have almost nothing in common.

It should be clearly understood that intestinal bands are *not* intestinal adhesions. Bands and adhesions are distinct pathological entities, definitely capable of differentiation by the radiologist. Bands are adventitious veils or membranes (Fig. 1). They take their fixed point from some place on the parietal or visceral peritoneum and pass out across the free border of the bowel to a greater or lesser distance. In the process of organization and contraction they cause the bowel to infold on itself longitudinally, with resulting narrowing of calibre, or transversely with the production of angulation. This is shown graphically in Figure 1. This constriction or angulation, as the case may be, not only produces stasis, with resultant toxemia, but also reflexly disturbs the innervation and upsets the normal equilibrium of the affected area.

Intestinal adhesions, on the other hand, are always the result of a local peritonitis, caused by injury either mechanical or chemical or bacterial.

Bands are quite easily removed. Their removal gives relief from symptoms, and they do not frequently recur. Adhesions, on the other hand, are difficult of removal, are not always incompatible with good function, and tend to recur after their removal.

In this report we are dealing with intestinal bands and *not* intestinal adhesions. Out of the 123 cases, 87 had constricting bands of the large and small intestines.

Adhesions, that is, one peritoneal surface glued to another, are comparatively rare in connection with the large bowel except in gynecological cases. Where they are not due to a generalized plastic peritonitis (e. g., tuberculous peritonitis) or an acute local peritonitis (e. g., appendiceal abscess) they are nearly always postoperative—the result of poor surgical technique.

Bands on the other hand, are very frequent, as this series shows. That their radiological diagnosis is con-

Fig. 10—Mr. McK., age 60. Complaint: Pain in right shoulder, following injury one year ago. Nausea with chills at times. History: Shoulder pain one year. Nausea and chills since childhood. Diagnosis: Teeth infection. Non-rotated cecum. Osteo-arthritis right shoulder.

Fig. 11—Mr. McD., age 22. Complaint: Left lumbar region pain, since injury. History: Notices spine bending sideways. Duration of symptoms one year. Diagnosis. Tonsils infected. Sigmoid banding. Spondylitis of fourth and fifth lumbar vertebra with sacralization.

Fig. 12—Mr. G., age 42. Complaint: Pain in right knee. Rheumatoid swelling of many small joints. History: Extends over years. Diagnosis: Chronic cholecystitis. Chronic appendicitis. Ankylosis of patella.

Fig 13—Mr B., age 59. Complaint: Pain in lumbar region and right hip. Epigastric distress. History. Lumbago for twelve years. Diagnosis: Infected teeth. Banded ascending colon, with cecal dilation. Spondylitis of third lumbar vertebra.

firmed operatively, that they are productive of symptoms, that these symptoms are relieved by their removal, the following statistics will demonstrate.

In a former paper[1] I showed that the radiological diagnosis of intestinal bands was confirmed in every case in a series of one hundred and thirty-five operations.

In a paper read by my colleague, Dr. Bigelow[2] the results of surgical removal of bands in a series of cases are reported. Questionnaires were returned by one hundred and five patients who had been operated for removal of bands of the large intestine or terminal ileum. The general symptoms, for the relief of which the operations had been done, as reported by the patients, were completely relieved in 37 per cent of the cases, much improved in 45 per cent, and somewhat improved in 15 per cent. Any surgical procedure which produces beneficial results in 97 per cent of operated cases should challenge the attention of those interested in the treatment of similar conditions.

Another colleague, Dr. Cromarty,[3] has analyzed the results of 40 consecutive operations on duodenal bands or membranes. These were all diagnosed by the radiologist and their diagnosis confirmed at operation. All had been subjected to prolonged medical treatment without improvement. The main symptoms complained of were epigastric pain and localized epigastric tenderness, nausea, and, to a lesser degree, eructations of gas. Questionnaires, returned by forty operative patients, showed relief from pain and tenderness in 88 per cent of the cases, relief from nausea in 80 per cent and from gas eructations in 55 per cent.

These statistics with their story of the reliability of the radiological diagnosis of intestinal bands, of the ability of these bands to produce symptoms, and of the possibility of relief from these symptoms by the correct surgical treatment of these bands, surely justifies the radiologist in an enthusiastic advocacy of the search for intestinal pathology as an etiological factor in chronic diseases.

The frequency of the occurrence of such intestinal bands, and of chronic appendicitis and cholecystitis in individuals suffering from chronic deforming arthritis certainly justifies one in coming to the conclusion expressed by Mutch.[4] In a paper contributed to the Lancet he summarizes the outlook on chronic arthritis in these words: "The condition of the alimentary tract dominates the outlook in rheumatoid and osteo-arthritis."

A few case histories are appended. They are not selected cases, but picked at random. The illustrations show the arthritic lesion in each case. Where colon banding was the associated intestinal lesion no attempt has been made to illustrate it, since banding of the large bowel is diagnosed fluoroscopically and is not usually susceptible of demonstration in the radiograph.

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Ultra-Violet Radiation in Malignancy*

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ULTRA-VIOLET radiation is not a fitting agent for the immediate treatment of malignancy; but it occasions in the body certain well defined physiologic responses that, indirectly, assist materially in the better handling of these cases when used as an adjuvant to whatever means the therapist may select in attacking the growth itself.

For the sake of convenience it is adequate to group the uses of ultraviolet radiation in these cases as, (1) remedial and (2) corrective.

REMEDIAL INDICATIONS

1. *Calcium Metabolism.* Clowes and Frisbie investigated the inorganic constituents of tumors and found that rapidly growing tumors contain much potassium and little calcium; and, contrariwise, slowly growing tumors are rich in calcium and low in potassium. There appears to be a ratio between the potassium and calcium content of a tumor that is most favorable to rapid growth; and this ratio is expressed as .

$$\frac{K}{Ca} = \frac{2}{1} \text{ or } \frac{3}{2}$$

* Received for publication July 10, 1923.

Beebe's work, supported by the findings of Clowes and Frisbie, is confirmatory of the observation that in proportion as the calcium content of a tumor increases, the growth rate of the tumor diminishes.

Experimentally, Goldzieher appears to have established that the injection of calcium salts into mice decreases their susceptibility to inoculated cancer; and Cramer, on exposing cancer cells to calcium salts, found their growth capacity when inoculated to be reduced.

Cancer cachexia, which is not considered to be different from cachexia attending other conditions, shows a high elimination of mineral salts such as is found in tuberculosis, and called "demineralization" by Robin. And the blood in cancer contains less calcium than normal, which results in the tendency to osteoporosis (Goldzieher) and to the deposition of the mineral in the epithelium of the kidney (Cramer)

From all of which it is reasonable to ascribe to calcium an inhibiting action against

1. The virulency of the cancerous growth itself; and,
2. The trend to metastatic spread when the tissue fluids are normal or high in calcium.

There is, obviously, much ground for the therapeutic desirability of keeping a high calcium content in the blood in the treatment of malignancy; and this situation, as is well established, may be simply and efficiently occasioned through the use of biologic or air-cooled ultraviolet radiation. The studies that have led to realizing the calcium raising effect of biologic ultraviolet radiation are due to Hess, followed by Tisdall. They have been satisfactorily ascertained in the case of rickets, upon which subject many prominent investigators have amply reported.

One indication for the use of biologic ultraviolet radiation in malignancy, therefore, centers around the role played by calcium and the ability to keep this mineral at a high level in consequence of the action of the energy on the body.

2. *Iron Metabolism.* There is always, in malignancy, a secondary anemia due to cachexia which expresses a general decrease in all the elements of the blood, both cellular and chemical,

Nothing very definite is known about the effect of ultraviolet on the blood; though the consensus of many observers seems to incline to the positive evidence that there is a decrease in the red count and in the percentage of hemoglobin in the dark, and an increase in the light, especially under biologic ultraviolet radiation, after long exposures in the normal individual. In those showing a secondary anemia, however, ultraviolet energy raises the cell and hemoglobin content much more rapidly than in the normal.

In my belief, the anemia of malignancy is improved by ultraviolet radiation not because of any immediate bettering of the iron metabolism (such as the change in the calcium metabolism that follows ultraviolet irradiations), but rather because of the general systemic uplift that these biologic radiations impart; although, in chlorosis, ultraviolet acts favorably and promptly affecting the iron metabolism and reorganizing the endocrine balance of the patient.

Following general bodily exposures to ultraviolet energy, the red cell count remains, at first, stationary; but the hemoglobin rather steadily increases. Later, when the hemoglobin has been raised 10 to 15 per cent, the cells and hemoglobin augment simultaneously. Nothing is observed in the cell or hemoglobin content until after twelve or fifteen bodily irradiations have been given.

So that a second indication for the use of ultraviolet rests in the tendency that this energy exhibits in increasing the hemoglobin and red cell count, thereby correcting, somewhat, the anemia.

3. *Leucocytes.* Under radiotherapy, those cases of malignancy seem to do best when the leucocytes are normal or above normal in number. This casual observation has been confirmed by the opinion of radiotherapists with whom it is my privilege to consult.

Now, white blood cells, as distinguished from red blood cells, readily respond to short exposures of any radiation (such as sunlight, ultraviolet, x-ray, heat). Of these radiations, the response elicited by ultra-violet is less striking than that incident to any other radiation; but all authentic reports agree in the conclusion that this actinic energy stimulates a leucocytosis in men and in animals.

Janet Clark, in her researches, found that lymphocytosis is induced by ultraviolet wave-lengths shorter than 3300 Angstrom units. Nothnig can be advanced that explains the mechanism underlying the leucocytic changes produced by biologic ultraviolet radiation; but, as Janet Clark mentions, presumably the lymphocyte-forming organs are stimulated to greater activity through some photo chemical change precipitated by the rays.

In malignancy, as in uncomplicated tuberculosis, the air-cooled ultraviolet radiation appears to strike a polynuclear instead of a lymphocytic response. It is difficult to determine this point because of the interference that is subscribed by the use of radium or x-rays at the same time. Tumors removed by diathermic surgery offer the clearest study; and in several cases of this sort, when air-cooled ultraviolet was also used, the cytolytic changes effected the polynuclear cells, whose number increased.

A third indication for the use of ultraviolet in the adjunct treatment of malignancy is explained by the polynuclear increase that the radiation may engender in these patients.

4. *General Metabolic Effect.* Ultraviolet exerts an influence on body metabolism. This is experimentally indicated by

1. Changes in the quantity of expired CO_2;
2. Changes in the rate and depth of respiration;
3. Increased rate of growth in light as compared to the growth in darkness.

There is much to show that the cachexia of cancer produces metabolic changes not unlike those that accompany fever. This is true for the nitrogen metabolism which, in cancer, behaves like the nitrogen metabolism in tuberculosis.

As was discussed in the *Journal of Radiology* for November, 1922, ultraviolet energy acts as a metabolic pacemaker; so that its influence in adjusting and equilibrating perverted metabolic processes, lends much to the symptomatic treatment of cancer.

Numerous investigators report a decreased alkalinity in the blood in cancer; others, by means of H-ion titrations, report the reverse. Of twelve specimens taken from cancer patients,[9] my own H-ion titrations seemed to point to an existing acidosis, contrary to the findings of Menten; but these results cannot be considered as conclusive, because of the imperfect determination owing to the colloidin dialysing technique personally employed.

For the present, the exact data on the effect of ultraviolet energy on metabolism must remain unpublished until the subject receives more study and control experimentation; but the evidence so far at hand, points to the general acceleration of all metabolic processes that, in cancer and in cachexia of whatever origin, are usually suppressed by the toxic influence of the invasion, replacing exogenous by endogenous metabolism.

2. CORRECTIVE INDICATIONS

1. *Radiotherapeutic Trauma.* Should telangiectases appear consequent to radium or deep roentgenotherapy, the ultraviolet energy finds valuable application. Prolonged exposures, possibly even to the point of blistering, and sometimes best when applied under compression from a large quartz lens, very usually remedy telangiectatic pathology.

Ulcers brought on by x-ray or radium exposure, like ulcers from any cause save syphilis, respond best to ultraviolet energy. Chronic sluggish ulceration in which epithelium refuses to grow, can be treated with hopefulness, as is illustrated by the following case, taken from the Southern Medical Journal, and reported by Dr. Jack W. Jones:

> "D. B., a male, age 12, referred by Dr. Hoke, came into my office January 12, 1922, and was entered with a diagnosis of dermatitis traumatica. The following history was obtained: Eight years previously he developed an osteomyelitis in the left leg. He was operated upon several times by different physicians and treated in various ways, until sixteen months before presentation, when he came to Dr. Hoke, who operated upon him for the same condition. Seven months after operation he was sent home with the leg entirely healed. It remained in this condition for about seven months and the boy was apparently leading the normal life of a school boy.
>
> "Following a slight injury, a sore developed on the old scar tissue and despite treatment two more formed. All of them refused to heal under the usual type of treatment. When I examined him, there were three lesions over the tibia, extending from the middle of the lower left leg to the ankle. These lesions were about the size of a quarter. The lower one was draining some pus. The upper lesions showed unhealthy granulations, a bluish color and numerous crusts scattered around them. The skin and scar tissue around them were very thin and resembled parchment. X-rays of this leg by Dr. Hoke showed nothing pathological. Routine laboratory examinations were negative. The boy's general condition was good. He was started on daily radiation with the ultraviolet rays, ranging from one and one-half minutes the first day to eighteen minutes during the latter part of treatment, with a fifteen-inch distance. The lesions be-

gan to show improvement after the fourth day. After the first ten days, treatment was instituted every second day. On the twenty-eighth day, the lesions were healed. The epithelium covering the scar tissue was firm and looked as healthy as the skin on the other part of the leg. The leg showed a good coat of tan from treatment and the bluish-red color had disappeared. The patient was discharged on the thirtieth day and advised to expose the leg one hour each day to the sun's rays. From last reports the condition has remained well and the skin seems to have regained its healthy tone."

A consideration in the ultraviolet treatment of ulcerated skin surfaces has to do with the dosage of radiation used. Customarily, each actinic exposure following the first is increased in order to compensate for the diminished susceptibility imparted by the erythema and tanning. In ulcerated surfaces, where the pigment layer of the skin is missing, the protection is not established; and the newly formed granulations should not be rayed for too long a time, as this leads to their destruction rather than to their stimulation. The subject is discussed more completely in an article submitted to the American Journal of Radiology and Electrotherapeutics.

Becker, at Frankfort, claimed in 1915 that ultraviolet radiation increases the tolerance of the skin to x-ray dosage. This has never been conclusively proved. All of the foreign and, recently, American literature that has been carefully studied convinces me that the authors of these statements have applied x-ray doses to the skin that are far below the erythema dose; that they have not taken into consideration the unusual variations in skin sensitivity exhibited by various individuals, and by the same individual when treated with variously filtered x-rays; that they have used x-rays in unprecedented fashions, such as for "ionic" effects, or for conditions that are speedily influenced, and therefore far from the more accurate (though still imperfect) estimate of x-ray erythema. As far as personal observations on my own skin are concerned, nine ultraviolet tanned and nine untanned discs subjected to x-ray became equally erythemic, the heavy ultraviolet pigmentation failing entirely to prevent the x-ray erythema from arising as compared to the untreated area.

It seems to me imperative that judgment on this matter be somewhat reserved. Enthusiasm in the belief of the premise, if unfounded, and there is certainly nothing yet definite or plausible in the way of proof, may lead to quite serious consequences.

The treatment of x-ray and radium dermatitis has been discussed elsewhere,[11] from which study the following summary is reproduced:

1. "Ultraviolet energy may be used as a preventive against the erythema produced under x-ray exposures.
2. "Ultraviolet energy, through its cellular regenerative force, will assist in the reconstruction of indolent x-ray ulcers.
3. "In the treatment of acute and chronic x-ray and radium dermatitis the biotic qualities of the air-cooled and the abiotic qualities of the water-cooled equipment should be clearly and judiciously employed if best results are to be achieved.
4. "It is neither proved nor disproved that the application of ultraviolet energy, before or after an x-ray exposure, will prevent the damage to the cellular structures in depths greater than 75 or 100 microns. Aborting x-ray erythema through the use of ultraviolet energy must not be considered a corrective for the deeper tissue changes induced by x-ray and radium trauma.
5. "Air cooled or biotic ultraviolet energy is useful in every form of acute x-ray dermatitis; and in raising tissue resistance in chronic x-ray dermatitis. Water-cooled or abiotic ultraviolet energy, owing to its desquamative capacity, does much to relieve the prominent acanthosis that forms an inherent part of chronic x-ray and radium skin changes."

Methods

For the remedial indications listed, the air-cooled or biologic ultraviolet energy is best suited. It is given "generally", by exposing the entire front and back of the body, to the ray. For the best effects, the operating voltage of the Uviarc should be 70. The distance from tube to skin, 40 inches. A stimulative reaction is sufficient, and is produced, under the operating conditions just mentioned, in the following time, depending upon the age, sex and endocrine type of the patient:

General or Systemic Irradiation

Air-cooled lamp; volts, 70; tube-skin distance, 40 inches; central ray strikes at right angles; average approximate exposure values, in seconds:

Erythema

	Stimulative	
	Light	Dark
Female adults	50	60
Male adults	60	90

The eyes must be protected, by keeping them closed, or by the use of goggles. The exposures should be given daily, each exposure being increased in time in amount equal to the first exposure.

For telangiectases, the area involved is heavily rayed, at least to the point of regenerative erythema, and possibly even to the extent of blistering. Sometimes, quartz lens compression appears to assist materially, as Casenberg correctly remarks. The air-cooled lamp had best be operated between 80 and 90 volts, with a tube-skin distance of 10 inches. The time for the initial raying is, approximately:

Intensive Irradiation

Air-cooled lamp: Volts 80 to 90; tube-skin distance, 10 inches; central ray strikes surface at right angles; average approximate exposure values, in seconds.

Erythema

	Regenerative		Desquamative	
	Light	Dark	Light	Dark
Female adults	20	30	40	60
Male adults	30	40	60	75

When the compression method, as suggested by Casenberg, is used, the water cooled lamp, furnishing a more powerful abiotic radiation, is utilized. A suitable quartz lens is fitted to the lamp, and with the uviarc operating between 50 and 65 volts, the telangiectatic area is attacked by firmly compressing each portion. The object of the compression is to exsanguinate the blood capillaries that form an effective barrier to the radiation. From 1 to 3 minutes is sufficient exposure time over each compressed area.

Summary

Air cooled ultra violet radiation

1. Increases calcium metabolism, which influences the virulency of existing toxicity and renders metastasis less likely.
2. Tends to increase iron, and thereby corrects the secondary anemia.
3. Produces a polynuclear leucocytosis in cases of malignancy; considered a valuable prognostic in the treatment of these patients.
4. Readjusts the general metabolic activity, thereby checking the cachexia.
5. Corrects telangiectasis.
6. Is helpful in radium or x-ray burns.

7. Does not, apparently, materially increase the skin tolerance to x-ray erythema sufficiently, if at all, to be of therapeutic aid.

Because of these qualities, the biologic ultraviolet radiation is useful as an adjunct in the treatment of malignancy.

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EDITORIAL

The JOURNAL OF RADIOLOGY

A Journal of Ideas and Ideals.

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American College of Radiology and Physiotherapy

AS A sufficient guaranty that the concomitant trust imposed in them by the recognition accorded the American College of Radiology and Physiotherapy by the American Medical Association, the officers of the former can only promise a vigorous and prudent administration of its affairs and offer as a pledge of performance their reputation as members of the American Medical Association and their standing as citizens in the community in which they respectively live.

For the benefit of those who may not have enjoyed the privilege of reading the November issue of the American Medical Association Bulletin—which be it known is the official journal of the House of Delegates of the Association—the comment of that body is quoted at length:

"ANOTHER AMERICAN COLLEGE

"The American College of Radiology and Physiotherapy was organized at Omaha, September 18, 1923. According to the Journal of Radiology, the new college is modeled after the American College of Physicians and Surgeons, and 'is the logical result of the action taken by the American Medical Association at its latest annual meeting in San Francisco.' The action referred to was the adoption by the House of Delegates of the report of the Reference Committee on Sections and Section Work, containing the following:

"1. We especially endorse the recommendation that no changes be made in the number of sections of the Scientific Assembly. This opinion already has the approval of the House of Delegates, as expressed at the St. Louis session.

"2. We feel, however, that the Association should recognize the increasing importance of special medical activities, such as radiology, physiotherapy, and occupational therapy; and to that end we wish to express our approval of that portion of the resolution offered by Dr. Van Zwaluwenburg, which provides that, wherever possible, every section program should contain at least one paper on a subject pertaining to some other specialty of particular interest and importance to members of the section, and your committee makes such recommendation.

"In view of the fact that laymen are attempting to practice radiology, we recommend that the American Medical Association recognize the science of radiology as an integral part of medicine and surgery.

"The Journal of Radiology presents a list of twenty-six organizations that have already received recognition by the American College of Radiology and Physiotherapy, seven of which are national in scope, while seven appear to be district or sectional bodies, eight state societies, and four strictly local organizations. Similar recognition is to be accorded other like organizations on the presentation of appropriate credentials.

"Samuel Beresford Childs, M.D., Denver, is President, and Roy W. Fouts, M.D., Omaha, is Secretary of the newly organized college."

It is the desire of the founders of the College, as well as its officers, in this early stage of its existence, to express the hope that the utmost spirit of harmony and cooperation shall exist between the American Medical Association, the American College of Physicians, the American College of Surgeons, and all other reputable medical organizations, and the American College of Radiology and Physiotherapy.

For the purpose of insuring this harmonious conduct of its affairs, one of the requirements of membership in the American College of Radiology and Physiotherapy is membership in good standing in the local county medical society, and it is very gratifying indeed that applications from medical men of this high character are being received almost daily.

Probably the greatest hindrance toward the progress of the sciences of radiology and physiotherapy in the past has been the apparent blinking of eyes over the question as to who should and who should not be recognized as competent to practice in these phases of medical science.

For once and all the American College of Radiology and Physiotherapy states the fact fearlessly and in uncompromising manner that no serious objection can be raised to the view that no man or woman can practice these integral parts of medical science without proper and solid grounding in medical science itself. The logical corollary of this proposition is that it is the bounden duty of those reputable practitioners of these phases of medical science to raise the standards of their profession as thus specialized and to defend them openly before the world in conformity with the ethics of the great medical profession of which they are a part.

For this reason, the American College of Radiology and Physiotherapy will espouse only those tenets of, and developments in, these phases of medical practice which have sound relation to the science of medicine, and have for their object the prevention and relief of human suffering.

In the pursuit of these ideals, it is earnestly believed that the American College of Radiology and Physiotherapy can do much toward elevating and forwarding these phases of medical science, and eliminating much of the disappointment and dissatisfaction of many of the practitioners in these specialties over the fact that their labors are not as comprehensively recognized as they feel they rightfully should be. The officers of the College feel that the greatest curative for this condition can be found in the improvement of method and precept by which the men engaged in these specialties measure their conduct with their fellow practitioners and the public, and to that end unswervingly is the American College of Radiology and Physiotherapy dedicated.

With this statement of purpose of the College and allegiance to all recognized reputable medical organizations, it is hoped that coordination of effort will follow unequivocally because there is much work to be done.

Necessity of Cooperation Between Radiologist and Physiotherapist and Surgeon

RADIOLOGY and physiotherapy are two distinct entities, therefore I shall discuss them separately in their relationship to surgery.

The science of radiology has become, I should say, next to that of sepsis and antisepsis, the greatest aid to the surgeon of all the allied medical sciences. Diagnosis and treatment of surgical conditions that come under the scope of radiology have become so dependent on the x-ray that it is hard to conceive how the surgeons of past generations managed their work so well as they did. The fact then is self-evident that the best results can only be obtained by the very closest cooperation between surgeon and radiologist.

How can this close cooperation be thus accomplished? First of all the radiologist must have a properly equipped laboratory to produce accurate radiographs of the various pathological processes. Just as important as this is his ability to correctly interpret the radiograph so reproduced. Consequently his knowledge of pathological conditions that can be shown by the x-ray must necessarily be extensive and complete.

Among the most important pathological processes the radiologist is called upon to examine are fractures, dislocations, foreign bodies, calcareous deposits, bone diseases, bone tumors, joint diseases, empyema, lung abscesses, gastro-intestinal surgical conditions, genito-urinary surgical conditions, deformities, anomalies, sinuses, and alveolar abscesses.

It is just as important for the surgeon to possess accurate knowledge of pathological processes that can be shown by the x-ray and to be able to recognize them in the radiographs. If he does he should have the advantage over the radiologist in that he has greater knowledge, as a rule, of the case history which is often very helpful in determining the correct diagnosis. Having this knowledge he can be helpful to the radiologist by giving specific suggestions regarding the pathological process that is to be determined. For example, let us suppose that we have a suspected case of lumbo-sacral arthritis which may show symptoms leading to suspect stone or stricture of the ureter, appendicitis, or tub-ovarian disease. The surgeon in such a case should request a stereoscopic radiograph of the lumbo-sacral region, together with an enumeration of the pathological conditions which he has under consideration. Without a good stereoscopic picture of this portion of the skeleton it is risky to venture a diagnosis or what is worse, report negative findings, unless the process is well advanced. Such a case has only recently come under my observation after going through the hands of many doctors, including surgeons, urologists, and radiologists, undiagnosed and consequently variously and improperly treated.

While on this point let me urge stereoscopic pictures of all difficult joint cases. You will be able with a good stereoscopic radiograph to pick up detailed joint pathology where it might not even be suspected in a flat plate. A good example of this is the erosion of the head of the humerus that is often seen in chronic subacromial bursitis. Likewise, stereoscopic pictures of the knee joint will show derangements in structure such as injuries to the spine of the tibia, and arthritic changes that can oftentimes only be suspected in a flat plate.

Accurate diagnosis of the various bone growths and diseases are often dependent on the case history; so let me urge here again that the surgeon and radiologist get together before making a decision that is so often of very great concern to the patient.

In the management of ambulatory fractures I would suggest that the radiologist be equipped with proper facilities for handling cases that require an anaesthetic for reduction and also an immediate x-ray examination. The latter should be made either fluoroscopically or by films while the patient is still under anaesthesia, so that if the reduction is not correct it can be corrected without the necessity of another anaesthetic. There is nothing quite so satisfactory, I believe, in the treatment of fractures as to do the job at one sitting.

The numerous vague indefinite requests often sent in to the radiologist by the referring physician are a source of worry, a waste of time and often result in a loss in accuracy. Patients are sent to the radiologist, for example, with simply a request for an x-ray of the leg, or arm, or back, or what-not. In all probability if it is an arm the patient will be wearing a splint or cast or a bandage. The radiologist is at once perplexed and often bewildered to know just what part of the arm he should radiograph to show the presence or absence of the pathology suspected. He may get a little information from the patient as to what part of the bone is injured or diseased, but this information is often misleading or incorrect. He is not allowed to remove the splint or dresing to determine accurately for himself, and so must guess more or less as to the location of the injury or disease. If he guesses right, "Eureka, all is well," but if he does not, he has to try another region or else call up the referring surgeon for the desired information. Such a predicament can easily be avoided if the surgeon sending in the case will only take the time to write out specific instructions to the radiologist. For example:

"Dr. Roentgen:—

"I am sending you Mr. John Doe, who has a fracture of the ulna at the junction of the upper and middle thirds. Please x-ray same, taking antero-posterior and lateral views and report findings by telephone."

The case can be examined immediately without any information from the patient, and the surgeon supplied with the desired information without any delay whatsoever.

While on this point I cannot urge too strongly the necessity for antero-posterior and lateral views of all fractures of the long bones. So often we see a fracture apparently in perfect position and alignment in one view and the opposite view shows the fragments completely offset and perhaps overlapping.

Similar errors in fractures in the region of joints can be detected by stereoscopic radiographs. This is especially important in fractures of the neck of the femur. A single plate may show the fracture apparently in perfect position whereas a stereoscopic view will show a complete offset. If this offset is not recognized and corrected a non-union is almost certain to result, regardless of how long the fracture is immobilized. I am convinced that non-union in fractures of the neck of the femur is caused by improper reduction much more often than by the poor blood supply of the neck, so frequently blamed. This improper reduction and consequent non-union can nearly always be avoided if the fracture is immobilized in the extreme abduction, or Whitman position.

Specific instructions from the surgeon as to which particular region of the spine is to be radiographed is most important, together with a suggestion as to the pathology suspected, or else a very brief history of the illness or injury. This is necessary in order to focus directly over the diseased or injured vertebra. I might suggest the following: Cervical, upper dorsal, mid-dorsal, lower dorsal, dorso-lumbar, lumbar, and lumbo-sacral. Stereoscopic views of the spine are invaluable, as they show much more in detail the inter-vertebral spaces and articular processes.

In contrast to the radiologist whose field is largely that of diagnosis, the physiotherapist is concerned entirely with treatment or restoration of function of injured or diseased parts of the body. His field is almost entirely confined to damaged joints, muscles and ligaments. He accomplishes the repair of the damaged parts by the scientific use of massage, manipulation, exercises, gymnastics, moist heat, dry and radiant heat, contrast baths and electric stimulation.

He does the case usually weeks and often months after injury or onset of the disease, and attempts to restore normal or improved function of the part in the shortest time possible. This is necessarily a most important part of the treatment of any case. He should therefore have sufficient knowledge of each case to anticipate the possibilities and limitation that each case presents. Unless he has this knowledge he is likely to do damage where it might be avoided, by applying himself too vigorously, or else not get the desired result by perhaps being too cautious.

This desired knowledge can only be obtained accurately from the surgeon in charge of the case who is familiar with the degree of damage at the time of injury, and the progress of repair up to the time the physiotherapist is called upon for assistance.

The question often arises in the mind of the surgeon as to the proper time to begin physiotherapy. This necessarily must be answered differently for each individual case, but in general, the earliest possible time after injury that physiotherapy can be begun without further injury to the part the better, if the best results are to be obtained.

During the recent World War trained physiotherapists and reconstruction aids were a constant part of every well equipped hospital organization. They were constantly being called upon to massage and exercise muscles and joints of fractured limbs of patients who were still confined to bed in splints or suspended with weight traction. In this way muscles were kept soft and well nourished, and atrophy avoided; and joints were prevented from becoming partially ankylosed and weakened by long periods of disuse necessitated by long periods of immobilization of compound fractures. As soon as these cases became ambulatory they were sent to the physiotherapy department, where moist or radiant heat was applied and more vigorous massage and manipulation and gymnastics prescribed.

The result of this treatment in many caes is almost marvelous. I have seen cases of severe injury to the shoulder joint, in which bony ankylosis has followed, acquire enough sub-scapular mobility to give the patient almost as good function in the injured limb as he had in the uninjured one. Also cases of severe suppurative arthritis of the knee, treated by the mobilization method after operation, acquire complete range of motion; whereas, similar cases treated by long continued immobilization may result in complete destruction of the joint surfaces with resulting bony ankylosis, or what is worse, a few degrees of painful motion.

Delayed physiotherapy not only lessens the degree of restoration of function, but it increases the time required to restore function and subjects the patient to much more pain while this is being accomplished and also delays his return to useful occupation.

I think there are far too many surgeons who rely on their patients to work out their own stiff joints and muscles after a few vague instructions without any supervision whatever, or perhaps a few visits to the doctor's office at irregular intervals where they are greeted with some such remark as, "Oh, it will be all right, just keep on working it." Fortunately, nature is sometimes kind enough to fulfill this prediction, but how often do we see the reverse. The offices of the chiropractors and osteopaths are filled with just such patients, and others that have been improperly diagnosed who have, for example, injuries of the muscles and ligaments of the back that could be very effectively treated by a well supervised course of physiotherapy.

In conclusion let me urge every surgeon to sense the necessity and value of early physiotherapy; and likewise let me urge the physiotherapists to cooperate with the surgeon by acquiring from him the necessary information regarding the injury to be treated, and by keeping him posted on the progress or limitations of the case.

Equally important is the cooperation between the surgeon and radiologist as I have tried to point out, for without this cooperation accurate diagnosis of the various pathological processes that can be visualized on the x-ray films is often very difficult and perhaps equally often not made at all.

L. N. Ossman, A.B., M.D., *Salt Lake City*
(Read Before the Utah Society of Radiology and Physiotherapy, September 18, 1923)

Dr. C. L. Mullins

A MAN of wide experience, both in medical practice and the ordinary affairs of life, Dr. C. L. Mullins, of Broken Bow, Nebraska, the retiring president of the American College of Radiology and Physiotherapy, was able to bring to the College in its formative period an unusual fund of wise judgment and good counsel. Every organization needs this kind of service from some self-sacrificing man in

Dr C L Mullins, Broken Bow, Nebraska, Retiring President of the American College of Radiology and Physiotherapy Surgeon, Medical Service U S Army with service in the Philippine Islands during the Spanish-American War President of the Nebraska State Medical Association, 1918.

its early days, and the members of the College feel that they have been most fortunate in this respect, because of the vast opportunities for substantial service to the medical profession which open out before an organization of this character which is moved by sound principle, constructive policy, and the absolute will to put away all "petting parties." Mutual admiration societies are perhaps all right in their place, but they have no place in medical science.

Every conscientious medical man knows that the sciences of radiology and physiotherapy are only in their infancy, and that they have proved so useful as to warrant their most assiduous development along sound and carefully thought out lines so as to insure their fair and intelligent application in the practice of medicine by men of reputation and recognized standing.

The difficulty in the past has been that, like all other new scientific developments, these aids to the practice of medicine have been taken up by men wholly unqualified to administer them—men who have not been properly grounded in the fundamentals of medicine. Much has been said about laymen undertaking the practice of these branches of medicine, and assuredly that condition represents an evil which needs to be eradicated with all possible speed. But, mindful of the Scriptural injunction—"Let him that is without sin cast the first stone"—it would seem that those members of the medical profession who are interested and believe in the efficacy of these measures of therapy and diagnosis should band themselves together into a cohesive and practical organization in order that they may elevate their own standards, better their own specialty, and bring proper credit to the medical profession.

Having had the privilege of listening to Dr. Mullins expound his ideas with respect to the College, both in public gatherings and in private conversations, there is no doubt in the writer's mind that these were and are the thoughts which actuated him in the formation of the College. And, believing further, that the men who are now officers in the College realize the full portent of these things and the untold good which now lies within the hands of the members of the College if they have but the will to lay hold of it, it seems certain that the organization thus founded will go forward rapidly, travel far, and become a worthy monument to the inspiration which begat its conception.

So long as life lasts, Dr. Mullins will be an active participant in the affairs of the College, and a fearless standard-bearer in its slow but nevertheless triumphal march toward the achievement of those things in radiology and physiotherapy which all honest and honorable medical men so much desire.

Nobel Prize Awarded to Canadians

THE DISCOVERERS of insulin, Dr. F. G. Banting and J. R. Macleod of the University of Toronto, have been awarded the Nobel prize for their discovery of this great aid to the medical world. An especially pleasing incident connected with this award, an incident by which one's faith in his fellows attains a new root, is Dr. Banting's announcement that he intends to share his part of the prize money with his colleague at the University of Toronto, Dr. C. F. Best, whom Dr. Banting says also deserves to be known as one of the discoverers of insulin.

The well known Nobel prizes were left to the world by Alfred B. Nobel, the Swedish scientist, who first became famous through his discovery of dynamite. When he died, in 1896, he left a fortune, the interest upon which is awarded yearly in five prizes, each amounting to about $40,000.00. He stipulated that these prizes should be awarded to those whose work in the field of physics, chemistry, medicine, literature, and for the advancement of world peace, should prove to be of preeminent excellence, either as proved by the test of experience or so adjudged by experts.

Six other Americans have received this prize. In 1907 A. A. Michelson of Chicago University won the prize in physics; in 1912 Alexis Carrel, a native of France but now one of our citizens in New York City, won the prize in medicine; in 1914 T. W. Richards of Harvard University won the chemistry prize. Three of our great public men, Theodore Roosevelt, Elihu Root and Woodrow Wilson, won the peace prize in the years 1906, 1912 and 1918, respectively.

CASE REPORTS

Infectious Arthritis of Elbow: Differential Diagnosis, Treatment

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This subject is not presented with the idea of offering anything new in diagnosis but to present a method of treatment, which when applied early to properly diagnosed cases will do much to prevent surgical operations and consequent deformities. However, I feel it is not a mistake to briefly review the diagnosis, especially so when we see patients treated for rheumatism who in fact are suffering from syphilitic, tuberculous or gonococcic infection. The terminology used for the various forms of arthritis has never been definite enough for standard classification, as the nomenclature differs according to different authors, however, it is my understanding that infectious arthritis is due to bacteria or their toxic products and occurs as a complication of acute infections as well as local diseases of the ear, throat, teeth, abdominal and genito-urinary organs. The onset of the general disease is usually sudden and the joint involvement follows in a few days or somewhat later. The condition is usually polyarticular, the original joint clearing up early. There is pain, swelling, limitation of motion, loss of function and later deformity. It is often accompanied by glandular enlargement with secondary anemia, slight temperature, fast pulse, loss of flesh and sleep. The infection may continue giving rise to distention of the joint with serum or pus which may later require operative procedure and drainage.

Syphilitic arthritis may occur early and even precede the roseola. It is usually localized in the joints which fatigue rather easily, the pain is most marked at night or when the patient lies down and it is relieved by exercise.

Subacute synovitis occurs which affects a small number of joints, usually one or two at a time. A careful history of the patient, a positive blood or spinal fluid Wassermann and the absence of a local or constitutional disease should be sufficient for diagnosis.

Tuberculous arthritis usually comes on gradually. There may be pain and tenderness with limitation of motion, chiefly of extension and later flexion, supination and pronation. There is swelling of the joint with atrophy of the muscles, and tuberculosis is usually found in other parts of the body.

Gonococcic arthritis is an inflammation of the joint following gonorrheal infection. In many cases the original gonorrheal infection has disappeared and the joint condition has followed a remote or obscure focus, for instance in the pelvis or the seminal vesicles. With a history of previous gonorrhea, in the absence of recent constitutional or known local disease, posterior urethroscopic examination should be made.

The cardinal symptoms of acute rheumatic fever are sudden onset of a polyarthritis flitting from joint to joint, with fever and sweats, the rapid occurrence of anemia and absence ot crepitus. The hip and knee joints are most often affected and then, in order of frequency, the elbow, wrist, shoulder, ankle, spinal column and finger joints. Etiology is unknown. The causative association of the bacillus demonstrated by Schueler is not proved though there would seem to be no doubt that a certain number of cases are due to bacterial infection. Prolonged exposure to wet and cold and faulty nutrition aid in a diagnosis.

All joint inflammations should be treated as an infectious arthritis, except in those cases where a specific cause can be ascertained. First of all the source of the infection should be sought and eliminated. The patient should be kept in bed until the temperature is normal with elimination through the bowels, kidneys and skin. Local treatment should be directed with a view of increasing the local resistance, and this in my opinion can best be done by electrotherapeutics. The technique in using these modalities varies according to the individual operator, and the condition of the joint to be treated. The technique which I have used successfully will be described in the treatment of the following case which I wish to report.

Patient: Female, age 21, clerk in a store.

Personal history: Well up until May 5th except for one abscessed tooth first noted in December and occasional attacks of tonsillitis. Had usual diseases of childhood. No history of gonorrhea or syphilis. May 5th, patient complained of pain in right arm, also some pain in left arm, slight headache and nausea. Went to bed for a few days, when a physician was called who diagnosed rheumatism and prescribed the salicylates. Pain in right arm subsided in a few days but gradually increased in the left arm, and at the end of three weeks patient was no better and was advised to go to Excelsior Springs for baths. At this time the arm was swollen about the elbow to twice its normal size with complete loss of function, considerable pain and enlargement of axillary glands. After several days of baths and following the extraction of the tooth, the patient was informed by her physician that there was a malignancy and amputation was advised. Patient returned home and entered the hospital June 13th. Physical examination showed marked emaciation, loss of weight, left arm greatly swollen from the wrist to the shoulder particularly about the elbow, with large mass of palpable glands in axilla and loss of function of hand, wrist and elbow joint. X-ray examination showed the articular surfaces of the elbow hazy, indistinct and roughened, suggestive of an acute arthritis. The elbow joint was not aspirated but looked very much as though there was fluid in the joint.

Blood examination:

Red cells 4,400,000 with slight poikilocytosis.

White cells 10,000.

Polymorphonuclears 84 per cent.

Lymphocytes 16 per cent.

Wassermann negative.

Urine examination negative.

Temperature 99:5.

Pulse 100.

From the history of the patient, physical examination and x-ray findings a diagnosis of infectious arthritis was made and the following treatment given: Complete rest in bed with light diet, alkaline diurectics and laxatives. The entire body was given a daily actinic raying for three weeks, starting with the mercury quartz lamp 14 inches distance for 20 seconds, increasing 10 seconds daily for five days, then increasing one-half minute a day until the skin became tanned. In conjunction with this general raying the elbow and axillary region was given the deep therapy light and high frequency current with non-vacuum electrode twice daily for 15 minutes to each location for ten days. At this time the swelling of the glands in the axilla was gone and pain was considerably reduced. This treatment was then continued daily to the elbow joint except on every third or fourth day, diathermy was uesd to elbow with cuff above and below the joint using from 1200 to 1400 ma. for eight minutes at each treatment. At the end of two weeks patient left the hospital, but continued treatment every day for two weeks longer, then every other day for a period of four weeks. During the latter part of the treatment the galvanic current was used with the negative pole to upper dorsal spine and the positive pole to hand and wrist, for the purpose of stimulating the nerves and muscles of the arm. Patient was not able to flex the wrist to the dorsal position at this time. After the acute symptoms had abated tonsillectomy was performed. At the end of ten weeks from beginning treatment her physical condition was normal. The arm had very slight deformity and fully 85 per cent of normal function. At the present time, fifteen weeks from beginning treatments, there is no deformity and patient is working and experiencing no inconvenience or pain in using the arm.

ABSTRACTS and REVIEWS

Roentgen Ray Therapy Twenty Years Ago. William Allen Pusey, M. D., Jour. A.M.A. 81:1257-58, Oct. 13, 1923.

THE AUTHOR began the therapeutic use of x-rays in 1900. With the aid of Freund he elaborated a series of therapeutic indications which contained only one indication that proved inaccurate, i. e., the use of the rays to destroy bacteria in living tissue.

The newer technique can be used without long years of training to acquire it and this the author regards as the most important addition that has come into the field of x-ray therapy. Almost as good results were obtained in the old days if patience, care and time enough were given the problem in hand.

The German Roentgen Society. W. E. Schall, B. Sc., J. Roentgen Soc. 19:172-174, October, 1923.

THIS IS a brief review of the program presented at the Annual Congress of the German Roentgen Society which met in Munich, April 16th to 18th this year.

The author of this review thus expresses his admiration: "The abiding impression of the whole three days was the enthusiasm and interest which exists for radiological matters in Central Europe. An audience of six or seven hundred which comes and listens with evident interest to lectures lasting six hours a day for three days is a strange sight for an Englishman." No doubt, he says, some of the papers were too long and some should not have been read at all but he adds that one wonders nevertheless why a similar parliament of radiology cannot meet once a year in Great Britain.

Contributions by Voltz and Wintz and others "left the impression that the day of the many-hour single application of x-rays in order to give the carcinoma dose at one sitting is on the wane and that the technique of frequent smaller doses is coming more and more into favor."

Speaking of the commercial exhibits by the Austrian and German firms he is struck by the state of hot cathode tube production, far ahead of that in England, and also struck by the low prices. Open competition he believes explains why these facts are so.

The Value of Bedside X-Ray Studies in the Immediate Postoperative Management of Surgical Cases. James T. Case, M. D., F.A.C.S. Surg. Gynec. Obst. 37:417-418, 1923.

THE AUTHOR mentions the value of radiation in the postoperative treatment of malignant and tuberculous disease, and in the management of hyperthyroidism where it sometimes is valuable as an aid to surgery and sometimes is used alone. Fluoroscopic control is of great value in accurately locating radium used in the treatment of esophageal carcinoma, after gastrostomy or before resorting to it and in cancer of the rectum and the rectosigmoid, and in accurate placing of needles.

To ascertain whether obstruction has occurred following gastro-enterostomy or cholecystoduodenostomy, bedside radiological study is useful, for this study 10 to 15 grams of opaque salt is given in plain water.

Postoperative studies following gastro-enterostomy will show how the new opening is functioning and in what position the stomach empties most readily, whereupon the patient can assume and keep the optimum position. Untoward results in intestinal surgery may be explained by roentgen study, especially true when the contents have backed up into the blind end of the colon after iliosigmoidostomy. In the study of a fistulous tract, injection of the same is made with some opaque mixture. The position of drainage tubes or material may be verified and often impending failure turned thereby to success. Especially in ileus following upon abdominal operations is bedside roentgen examination of value in detecting the obstruction. The portable apparatus is used and within 15 to 20 minutes findings are made known. Usually no opaque material is needed for this examination and the patient is no more disturbed than when the bed linen is changed.

The Influence of Heredity on the Occurrence of Cancer. H. Gideon Wells, M. D., Jour. A.M.A. 81: 1017-1021, September 22, 1923 and 1103-1112, September 29, 1923.

THE MENDELIAN theory together with the discovery that sarcomas in rats and carcinomas in mice can be inoculated into other animals of the same species for an indefinite number of generations are the two discoveries that have placed cancer research upon an experimental basis.

In the question of human cancer heredity, all existing statistical evidence is valueless for exact information. Individuals cannot give reliable family histories and clinical diagnosis even in some of the best of the modern hospitals is proved at necropsy to be from 20 to 50 per cent in error. One single error in diagnosis or in history can destroy the value of a mass of data.

About the only thing that can be decided upon from existent data is that a larger number of relatives of cancerous patients have had cancer than have those of non-cancerous patients. However, the existence of "cancer families" cannot be denied and retinal glioma occurring in families is one of the unsolved mysetries. Many interesting instances of familial cancer of various types are cited from the literature. The author adds this parting remark: "As far as I can learn no one has sought out families that show an immunity to cancer."

Animal experimentation is next discussed under the heads of transplanted tumors, spontaneous tumors and mechanism of hereditary influence.

A transplanted tumor differs fundamentally from a spontaneous tumor in that it is a growth of the cells descended from the animal that furnished the original spontaneous tumor and is never a growth of the cells of the inoculated animal. A Jensen carcinoma carried throughout 20 years of transplantation is still a growth from the original cells of the spontaneous tumor from which it was first inoculated. Therefore, resistance to spontaneous tumor bears no relation to resistance to inoculated tumor. Several observations are here made and elaborated upon: (1) The liklihood of successful inoculation becomes more and more remote the more different in origin and character the inoculated mice are from the originator of the tumor. (2) Certain strains of animals are insusceptible to tumor grafts to which other strains of the same species are susceptible. (3) Heredity influences in a constant manner the susceptibility of a given strain of animals to inoculation with cancer. Tyzzer found that a carcinoma arising in a Japanese waltzing mouse could be inoculated into mice of the same type

with a large percentage of success but would not grow in common strains. When the waltzers were bred with the common mice "the mice of the first hybrid generation were all susceptible but the second and third hybrid generations made by cross-breeding the first generation hybrids were insusceptible. The mice of the first hybrid generation although they were susceptible to tumor inoculation, did not show the waltzing character of the susceptible parent strain, whereas the waltzing mice (recessives) that appeared in the second and third hybrid generation were not susceptible to inoculation with the dancing mouse tumor. Further studies carried out with numerous back crosses gave results that indicate that susceptibility to grafted tumors is not inherited as a single mendelizing factor, for they do not furnish a ratio characteristic of a single factor inheritance. Tyzzer and Little believe that both susceptibility and non-susceptibility are inherited as a complex of mendelizing factors, perhaps as many as twelve or fourteen in number."

Loeb and Fischer obtained results not entirely in agreement with those of Tyzzer but they do agree with him and Little that if susceptibility to these tumors is a Mendelian process it must depend on multiple factors.

Of spontaneous animal tumors he says: "(1) Cancer in mice appears in most of the forms seen in man, and in far greater variety than had previously been supposed. (2) The tendency to develop cancer or the capacity to resist cancer is unquestionably influenced by heredity. (3) The resistance to cancer in these mice behaves in breeding, in Slye's experience, like a typical mendelian dominant character. The susceptibility to cancer behaves as a mendelian recessive. (4) Not only the incidence of cancer is influenced by heredity but also its site and its character. (5) Behavior of tumors is influenced by heredity (localization). (6) Inbreeding is not of itself responsible for an increased susceptibility to cancer. * * Inbreeding merely concentrates existig characters but does not produce new characters. * * * In view of all the experimental evidence cited above and the absence of any expenimental evidence that contradicts it, the conclusion seems ineviatble that the incidence, character, location and behavior of tumors depend to some extent, at least, on the inherited qualities of the animal and of its tissues."

He begins the discussion of the mechanism of hereditary influence by asking how heredity determines susceptibility. Growth stimuli are of various sorts and non-specific. The same amount of stimulation does not produce an equal reaction in all individuals even though they be of the same species. Not the pathology itself, evidently, but the tendency to develop it is what is transmitted. In Slye's experience the hereditary factors of resistance to cancer may become so high in pure strains of selected mice that no ordinary amount of proliferative stimulus ever overcomes it, for strains of cancer-resisting mice have been developed that have not shown cancer throughout 30 generations of mice, which corresponds to a period of about one thousand years of human life, while on the other hand the capacity to resist cancer may be so bred out of mice that virtually all of a selected strain will develop neoplasms from ordinary proliferative stimuli. In the heterozygous human race maximum stimulation is almost always capable of overcoming resistance but conversely cancer often develops in tissues in which there has been a minimum amount of injury.

Under the topic of the relation of animal experiments to human disease he says: "Certainly these considerations fit well with what we do know of human cancer. Until some one has carried out the arduous studies necessary to confirm or refute Slye's conclusions, as to the exact way in which the demonstrated influence of heredity is transmitted, it may be fair to consider them as at least offering a reasonable explanation of the influence of heredity on human cancer."

In another place he says: "It is known that the principles of inheritance are the same in all species of animals as well as in plants and that cancer, in its fundamental respects is the same in man as in the other mammals; therefore the drawing of conclusions in respect to heredity and human cancer from observations on experimental animals is justifiable." Evidence supports the inference that in man as well as animals the susceptibility to cancer behaves as an inherited recessive character.

Studies on X-Ray Effects. Histological Study of the Fate of Cancer Grafts Inoculated into an X-Rayed Area. Waro Nakahara, Ph. D. Rockefeller Institute. J. Exper. Med. 38:309-311, September, 1923.

MICE WERE used in the experiments here described. By means of sheet lead in which openings had been cut the animals were rayed completely over the left groin and the rest of the body protected completely. The area was then given a dose of x-rays governed by the following factors: 3 inch spark gap; 10 ma.; 6 inch distance from the target; time of exposure 2 and one-half minutes. Seven days later cancer grafts were inoculated intracutaneously in both the x-rayed area and the area not rayed.

The author thus summarizes the study: "Cancer cells implanted in a skin region previously exposed to an erythema dose of x-rays shows a series of degenerative changes in every way comparable to the frequently described stages of cancer cell degeneration following x-ray treatment. These findings contrast strongly with the survival and growth of grafts implanted in unexposed regions in the same animal. Since the changes are the same whether the cells have been directly exposed in situ or merely implanted in the previously exposed skin, it follows that it is impossible to establish microscopically a direct injury from the x-raying as the principal factor in the therapeutic action of x-rays on cancer."

The Value of the X-Ray Report as a Liason between the Roentgenologist and the Referring Physician. Edward S. Blaine, M. D. Illinois M. J., 44:185-191, September, 1923.

THE VALUE of any x-ray report depends upon how well it transfers to the referring physician the information contained on the films. Very detailed findings are outlined for reports on the thorax, alimentary tract, urinary tract, sinuses, mastoids and skull and the author says that when such thorough analysis is generally adopted by roentgenologists that the value of the x-ray as an aid in diagnosis will rise to the place it should occupy in the medical field. Detailed reports do away with the necessity of the referring physician seeing the films, the fact that he now needs to see them is a reflection on the interpretation of many roentgenologists. A duplicate film should always be filed in any case. There is a great lack of uniformity in x-ray repots, too many are meaningless or inadequate and a more satisfactory manner of reporting findings should become standard.

In general a good x-ray report regardless of the lesion should contain the following:

1. Exact anatomical region included in the examination giving the limits in terms of the anatomy.

2. The projection directions, anterior-posterior etc.; posture of patient; number of exposures and films used and the size of films.

3. Whether the shadows of the bones correspond with the age, weight, height and sex of a normal individual of like age; main shadow features bearing directly upon the suspected lesion; secondary or additional changes.

4. Specific statement as to normal portions included in the examination.

The report should be specific and take nothing for granted or as unimportant.

Deep Roentgen Therapy and Skin Reactions. P. Del Buono, M. D., Naples, Italy. Am. J. Roentgenol. 10:745-753, September, 1923.

THE AUTHOR remarks that the terms *radiosensitivity* and *selective action* of a cell or group of cells with respect to x-rays have as yet no definite meaning.

The general consensus of opinion is that there is no such thing as a true idiosyncrasy for x-rays. The pathological phenomenon of idiosyncrasy is that a minimal dose of the drug or element produces shock but feeble doses of x-rays do not react violently, i. e., in burns, necrosis, etc. Either too short target distance or too large a proportion of soft rays may produce a skin lesion following x-ray diagnosis. Distance should be 40 cm. and a filter of aluminum or leather used.

However, it cannot be denied that there does exist a hypersensitivity and a hyposensitivity for x-rays on the part of some individuals. Age, complexion and area have something to do with this. Predisposition or an abnormal state of the skin on account of disturbances due to nutrition, growth or change, no matter how caused, may render a dose intolerable for one individual which for others would be a therapeutic dose.

The vascular system suffers most from irradiation and when the vessels have lost their power of defense changes in the tissues may proceed even to necrosis. The endothelial cells of the blood vessels are selectively radiosensitive. In larger doses the epithelium, the fixed connective tissue cells and the lymphatics are injured. The vascular endothelium is the last to recover. The capillaries of the corium are affected by very small doses, loss of elacticity first appears and the vasomotor system ceases to function well and the skin's power of resistance is handicapped. Larger doses may eliminate the lumen of the vessels.

Skin necrosis does not occur easily when the blood vessels are injured by the rays, for the reason that the vessels are not all injured to the same extent and that those which are more distant are uninjured and contribute to the supply needed by the tissues. But when there exists a weakness in the vessels small doses of rays may cause serious injuries. In nephritics the change which in a normal individual would not manifest itself for six days will appear in three days. This is also true in vagatonics and in Basedow's disease.

The thickened skin which always occurs after radiation is of no serious consequence providing that area is not again irradiated.

The boundary line between an intense erythema which heals easily and may be considered physiological and one which is pathological may be reached either by an excessive dose which works injury and shows effects after a very short latent period or by the cumulative action of the rays.

The different degrees of erythema as adopted by the different groups are described. Seitz and Wintz call that an erythema dose which produces soon after irradiation a slight redness which after three weeks will appear darker and in six weeks is bronzed. Less than 35 units of their electrometric system will not produce this change, more than 35 units will produce a severe reaction with a possibility of first degree burn. Friedrich and Kroenig with their unit dose secure an erythema much more marked than do Seitz and Wintz. Their erythema dose is identical with the so-called inflammation dose of Opitz. This produces an inflammation of the first degree accompanied by a temporary reddening; 170 to 180 "e" of their electrometric units give rise to the above reaction while 210 "e" produces a second degree erythema with excoriation of the skin and in many instances vesication. Warnekros finds a difference of 30 to 40 per cent in different patients in the amount of radiation necessary to produce the reddening and later tanning of the Seitz and Wintz dose. The maximum skin dose as he uses it is one that produces a pronounced dark red color of the abdominal skin, with papular separation of the epidermis and a profuse secretion from the raw surface. This dose is greater than the carcinoma dose in the ratio of 100 to 85 but Warnekros records no serious injury from its use. But the author of this paper says there always remains the question of whether the dosage can be exactly duplicated.

He says that the skin submitted to the penetrating doses used these days "not only should not be radiated again but should be protected from external injury (trauma) which may impede nutrition and delay or stop the process of recovery. There should then be no danger of late burns, since the steady improvement in the circulation and the recovery of the vital functions of the elements of the tissue cannot possibly account for the formation of late ulcer and necrosis. But this is not true if, at the time of recovery of its normal functions, the tissue be radiated again. The injury may not show itself immediately; years may pass, but finally, neither the defensive strength of the organism in general, nor the assistance rendered by the neighboring tissue, can save the tissue and prevent slow necrosis."

Rost, Kroenig and Friedrich from their studies have concluded that injuries are of similar character whether produced by radiations of long or short wave-length.

Finally the author says that "variations in the primary voltage may cause such changes in the tube voltage as to give considerable increase of dose, sufficient to account for all types of injury. Poor coal and defects in the electrical distributing system cause line fluctuations between afternoon and evening from 170 to 250 volts. This is sufficient to cause a good deal of trouble unless proper precautions are taken.

Roentgen Rays in Lymphogranulomatosis (Hodgkins Disease). Dr. S. H. Chaoul and Kurt Lange, Strahlentherapie 15:620-623, No. 5, 1923.

THE PATHOLOGICAL condition while so well described by Hodgkins, 80 years ago, is so far only known as a chronic inflammatory, infectious process of the lymphatic system, which, in a large number of cases, appears to be associated with tuberculosis. The causative agent is unknown. Roentgen ray therapy in this disease has met both successes and difficulties. The first enthusiastic reports by Senn who saw large tumor masses completely disappear under the influence of the rays were soon followed by disappointments when recurrences were found to arise from hidden granulomatous nests.

Better therapy succeeded in prolonging life from one to two years. Cases of patients who lived from 7 to 11 years after roentgen ray therapy were reported by Karl Meyer and Schwartz.

The difficulty in treatment, aside from recurrence, consists of the fact that the organism is heavily taxed to dispose of the albuminous material resulting from the sudden decomposition of these large masses. In cachectic individuals such sudden reaction assumes a menacing aspect.

Chaoul, therefore, gives a series of small radiations with short skin focus distance. One of the patients received a series of 37 treatments, and has been free from recurrence for two years. The technique used by Chaoul is as follows: 1 mm. copper filter, at each treatment 10 per cent of an erythema dose is given until 60 to 70 per cent is delivered within about

six weeks. At first treatments are given daily, then every second day, then every third day, finally one every week. Always a large field with the large gatherer (an instrument to reassemble scattered radiation?) is employed. In the generalized form the whole body may be treated. After three months a repetition of the course is given.

The authors agree with Holzknecht and Petersen that the complete disappearance of these tumors is characteristic of lymphogranulomatosis.

The authors treated 12 cases and with the exception of one where the mediastinum was involved they were all cured to the extent that they returned to work.

The following end-results are given: With the exception of two cases who died of some other disease, one with mediastinal Hodgkins died after eight months, and another after two years, and of the eight cases remaining there was only light recurrence in one, while in the others there is an average of two and one-half years without recurrence.

Regarding the blood picture the authors observed a marked rise in eosinophiles, at times up to 17 per cent, during irradiation, while previously, no pronounced eosinophilia was found. The authors consider the appearance of eosinophilia a good prognostic sign. No other changes were found except an absolute drop in leukocytes.

A. M. PFEFFER, M. D.

Differentiation by Swallowing Between Intra or Extra Pulmonary Site of an Opacity with Shadow Outline of the Apex. Dr. Josef Eordelyi, Klin. Wchnschr. 2: No. 33, August 13, 1923.

CIRCUMSCRIBED shadows in the apical region are of great diagnostic importance. It is, however, necessary to determine that such calcified shadows are of intrapulmonary and not of extrapulmonary origin. Such shadows often result from calcified glands within the soft parts of the supraclavicular fossa, or calcified spots in the enlarged thyroid.

The usual means of differentiation are: (1) coughing, allowing the patient to cough will at times move the spot outside of the pulmonary outline; (2) examination in various views which will often show a more clear-cut outline in one view than in another, thus showing its proximity to one surface or another.

The author found that the above means were insufficient in some cases, and he suggests that these cases be examined fluoroscopically, and the patient be asked to swallow. In swallowing most of the muscles of the neck and of the supraclavicular fossa are moved by the movements of the tongue and hyoid bone, while the lungs are in their usual position. An opaque spot moving with swallowing is therefore definitely outside of the lung tissue.

The author urges the use of fluoroscopy along with the roentgenogram in all cases where differentiation is necessary.

A. M. PFEFFER, M. D.

Examination of the Posterior Mediastinal Glands in the Early Recognition of Pulmonary Tuberculosis. Lloyd B. Crow, M. D., Am. J. Roentgenol. 10:699-701, September, 1923.

THE LYMPHATIC vessels of the lungs consist of two sets, the superficial (placed beneath the pleura and covering the outer surface of the lung) and the deep ones which accompany the blood vessels and run along the bronchi, terminating at the root of the lung or hilus region. These glands are intimately connected with those of the posterior mediastinum. The lymphatic vessels of the esophagus form a plexus around that tube, traverse the glands in the posterior mediastinum, and after communicating with the pulmonary glands and the vessels at the root of the lung, terminate in the thoracic duct. The posterior mediastinal glands are situated in the areolar tissue of the posterior mediastinum, forming a continuous chain by the side of the aorta and the esophagus, communicating on each side with the intercostals below and with the lumbar glands and the deep cervical above." There is, therefore, a possibility of infection from the nasopharynx and the buccal cavity directly to the hilus of the lung.

The patient stands at an angle of 45 degrees with the left scapula against the fluoroscope and the right shoulder touching the screen. This position must be varied so that the maximum amount of space between the heart and the vertebral column be obtained in the visualization of the postcardiac space. This is first done with the open diaphragm and if considerable infiltration has taken place the whole field will be darkened; if infiltration is fairly heavy then a chain of glands will be seen distinctly, extending from the upper portion of the hilus space to the hilus region, and in some cases to the inferior portion of the space; if infiltration is slight then thin narrow lines are seen extending downward like lines of rope. The glands in the upper and lower portions may not be visualized and many normal cases may show infiltration of the glands in the postcardiac space, in these cases there is usually a history of previous lung involvement. Recovered cases will show involvement of the posterior mediastinal glands but instead of general involvement they will appear as rounded shadows forming a chain with the appearance of scattered shot. The picture in advanced cases varies.

In conclusion the author states that his study of 4,000 cases has led him to believe that as a negative sign, the non-involvement of the glands in the posterior mediastinum possesses great value in eliminating pulmonary tuberculosis in suspected cases.

Two Cases of Localized Metastatic Carcinoma of the Vertebrae without Demonstrable Primary Lesion. Cyril P. O'Boyle, M. D., Am. J. Roentgenol. 10:711-714, Sept., 1923.

TWO CASES of metastatic carcinoma of the vertebral column are reported in which the primary focus was not demonstrated. Pain was the most prominent symptom and was manifest upon movement. Roentgen examination should be made in all suspected cases as they are usually readily diagnosed by such means.

Typical Disease of the Second Metatarso-Phalangeal Joint. Dr. Alban Kohler, Wiesbaden, Am. J. Roentgenol. 10:705-710, Sept., 1923.

AT THE site complained of the roentgenogram sometimes shows a joint-space of double breadth where the second or third metatarsals or both, articulate with the toes. There is a definite proximal displacement of the metatarsal involved. The disease is not especially a rare one, at least within the last two and one-half years the author has found many cases. The etiology is obscure. He believes that trauma plays a part but he also believes that a certain debility of the osseous system is probably largely a factor. This he believes is less infectious in nature than it is toxic, the general resistance of the organism is lowered and the effect becomes manifest at the point of greatest strain. As treatment he advises rest, poultices, baths, heat, massage, good food, air and sunlight and the use of a well fitted shoe with an inlay designed from a plaster cast.

Discussing the bony changes the author says: "The disease involves the articular surface of the base of the proximal phalanx of the second toe (seldom the third or both together) the metatarsophalangeal joint, the articular surface of the head of the metatarsal, the head itself, and the whole distal half of the metatarsal. These structures are altered in the

following manner: "(1) Shadow of articular surface of proximal phalanx in plantar-dorsal exposure loses its perfectly circular form, becomes irregular, often an S-shape. (2) Joint-space is usually broader than normal. (3) Broadening is strikingly irregular, the fibular half of the space being often double the tibial half. (4) Articular surface of head of metatarsus loses its normal roundness, is only more or less flat in early cases but in old ones it shows quite irregular knobs and defects. (5) In advanced cases there are from one to several shadows on the fibular aspect of the joint and even deep in the soft parts. These shadows vary in size from that of a pin head to that of a lentil and resemble the calcified plaques in the capsules of the large joints, but are always circular. (6) Head of the metatarsal is undoubtedly shortened in its distal third, as though the cap had been driven in. (7) In all frank cases the whole distal half of the metatarsal is more or less altered and is definitely increased in circumference so there is no longer a constriction at the site of the neck so that the distal half is often like the proximal in size and shape. The thickening is not confined to the medulla but involves the cortex, which however, thins out normally toward the proximal end of the bone. In contradistinction to osteomyelitis and spina ventosa is the increase in the size of the bone distally, and also the spongiosa as far as the tip of the bone appears regular and of well-ordered design.

Report of Results of X-Ray Treatment in Pyorrhea Alveolaris. G. Von Poswik, M. D. Am. J. Roentgenol. 10:724-725, Sept., 1923.

THE AUTHOR submits three case reports of pronounced cases of pyorrhea which he treated by x-ray radiation and which are seemingly cured as a result.

The author's plan is to take the patient's history and pay particular attention to oral conditions. Next a bacteriological examination is made, then an x-ray examination. Then the teeth are scaled and the dentist instructed not to use iodine or anything else that would contra-indicate x-ray treatment. No toothbrush is used. X-ray treatments are then instituted (p.r.n.) and bacteriological examination is made before each treatment. A weekly inspection is made.

With the first patient the author used the following technique: 6 ma.; 6 min.; 6½ inches; 8 inch spark gap and a filter of 2 mm. Al, 1 inch wood, 2 mm. Al, and sole leather. With the last two he used 5 ma.; 4 min.; 6½ inches distance, 8 inch spark gap and filter of 2 mm. Al, 1 inch wood, and sole leather. Does not say why technique was changed. Results were good in all three cases.

A Visit to Some South American Radiologists. James T. Case, M. D., F. A. C. S., D. M. R. & E. (Camb.) Am. J. Roentgenol. 10: 754-763, September, 1923.

THIS IS a very interesting account of the author's visit to the leading radiologists in some of the larger cities of South America. He mentions among other interesting things that at the new Institute of Surgery of the University of Buenos Aires he found for the first time in his experience a public teaching hospital with ideal roentgenological equipment. The culture and scientific attainments of these South American workers commanded the admiration of each American visitor. The private institutes of Carelli and of Heuser are said to be models from the standpoint of both equipment and art.

Dr. Heuser gave a demonstration of cases treated with deep therapy. Heuser believes in preoperative roentgen radiation of cancerous patients. In treating uterine fibroids he has succeeded in reducing the volume by 80 per cent and he recommends the removal of the remaining nucleus as it is difficult to forecast developments.

The Treatment of Uterine Fibroids with Roentgen Rays. With Illustrations of Original Appliances. James N. McCoy, M. D. Am. J. Surg. 37:238-240, September, 1923.

CONCLUSIONS by the author: "X-rays constitute the best possible remedy for uterine tumors except calcareous tumors and chrondromata. Hysterectomy is wholly unwarranted in the great majority of cases of uterine tumors. Hysterectomy is a grave operation with an appreciable death rate, while x-ray is without danger to the patient. Care of uterine tumors can be effected without producing the menopause or a dysfunction of the ovary."

Ventriculography: Its Place in Brain Surgery. George L. Davenport, M. D. Illinois M. J. 44:179-181, September, 1923.

THE AUTHOR has made use of this procedure in 28 cases of intracranial lesions. Operative treatment was instituted in 11 of these cases and nine patients died within from a few hours to seven months after the operation. Operative results should not be judged simply by the remote results and the mortality, for temporary results save these patients untold suffering and blindness.

Brain surgery, he feels, is bound to improve with the careful use of this procedure.

Fifteen Years' Experience with the Fractional Dose Method of Treating Cutaneous Malignancies. J. M. Martin, M. D., Am. J. Roentgenol. 10:726-733, September, 1923.

SINCE 1918 the author has used a Coolidge tube with interrupterless transformer, and has employed a more radical technique in treating these malignancies.

For a single exposure he uses a 10 inch target skin distance, 5 inch spark gap, 5 ma., ½ mm. Al placed just beneath the tube, time five minutes. Exposure is made every other day and the number of exposures ranges from two to ten. "According to the formula of Witherbee and Remer for filtered dosage, an erythema dose was administered at each sitting. The smaller lesions received from two to four exposures while growths of moderate size received six exposures. Only occasionally was it found necessary to use as many as ten exposures. The only factor that was varied with this technique was the number of exposures. The rays were in each case sharply limited by means of conese and shields to the lesion and a narrow strip of skin surrounding it. When practical, the skin covering the lymphatic channels draining the area occupied by the lesion was subjected to an erythema dose administered through heavier filters. Fifty ma. min. were given through 4 mm. Al and four thicknesses of sole leather with an 8 in. parallel spark gap and a target skin distance of 10 in. I have not seen fit to alter this technique and am using it at the present time." Most of the author's patients come from a distance and cannot stay longer than two weeks nor are they willing to return at monthly intervals which the single exposure intensive method makes necessary.

The single exposure has not yielded satisfactory results in the author's hands but he has found the majority of cases treated by the multiple dose method do not require a second series of treatments. In all but the small lesions a second degree reaction is produced no matter how large the lesion or where situated. He believes that treatment must be radical and that the neoplasm must be eradicated at the first series of treatments if at all. He has not found that atrophy, telangiectasis and keratosis are disturbing factors and the changes which do occur are so insignificant compared to the original lesion or to the changes produced by surgery that they can be disregarded.

Most of the author's patients come from a distance and cannot stay longer than two weeks nor are they willing to make return trips at monthly intervals which the single exposure intensive method requires. He routinely has a photograph taken of each patient who begins treatment and other photographs are taken during the course of treatments if anything interesting comes up When the patient is discharged and sent home he is given ten postcards addressed to the author, with the date upon which they are to be mailed written in red ink. He is to return one of these with the blanks filled out every six months and if he fails to do so he receives a written inquiry. The author has used this follow-up system for four years and expects eventually to have data worth consideration.

In conclusion he says: "From long experience we are of the opinion that repeated erythema doses of x-rays in the treatment of malignant conditions of the skin are productive of better results and more lasting effects than single dose methods. Our conclusions are based upon an experience of more than fifteen years during which we have treated more than 2,000 cases."

The Roentgen Ray Versus Vaccines in the Treatment of Acne. Howard Fox, M. D., Jour. A. M. A. 81: 1417-1421, Oct. 27, 1923.

ALTHOUGH not a serious disease as affects health acne affects the peace of mind of the individual and sometimes his earning capacity.

In the hands of a careful operator using modern apparatus and measured dosage the roentgen ray is safe and efficient and the results secured thereby are more permanent than by any other means.

Whatever value vaccines possess is restricted to their use in selected cases, chiefly of the pustular type or as an adjuvant to other forms of treatment. Their action is slow and often improvement is only temporary. The roentgen rays are far superior as a form of treatment.

Roentgen Diagnosis of So-Called Chronic Appendicitis. Dr. F. Ehrlich, Deutsch. med. Wchnschr. 48: 449, April 6, 1923.

IT IS the author's experience that in all normal cases six hours after ingestion of the barium meal the small intestine is empty and that the cecum, complete ascending colon and part or complete transverse colon are filled. Gross deviation is pathological and caused by pathological reflexes which either retard or increase the peristaltic movement

Chronic appendicitis is one of those pathological conditions which retards peristalsis. It may cause the retardation mechanically, as by adhesion formation, or in a purely reflex manner.

If after six hours a few of the last coils of the small intestine are still considerably filled, or if the meal has not yet passed into the ascending colon, in absence of gastric residue, of stenosis of the small and large intestines, and peritoneal disease, the author unhesitatingly diagnoses the condition as chronic appendicitis.

In 17 cases with only this one finding disease of the appendix or of some neighboring structure was found at operation. In one case a tuberculous condition of the ileocecal region was found.

The author finds this roentgenological observation pathognostic of chronic appendicitis even though there are no other grounds for such diagnosis but it is of no importance in differential diagnosis and the nature of the disease process cannot be inferred from this finding.

A. M. PFEFFER, M. D.

Physiotherapy. W. W. Carey, M. D. J. Indiana M. A. 335-338, October, 1923.

THE DEGREE of success met with in the practice of physiotherapy depends upon the knowledge of the modality used and the method of its application. Only study and experience can make the successful practitioner.

Neurotic patients are tremendously aided by physiotherapy. In neuropsychiatry the mere fact of treatment acts as a tonic and gives the patient courage to bear up until nature gets a chance to do her work.

Fractures and dislocations are aided by the absorption of inflammatory products and the prevention of atrophy. Hastening of bony union and promotion of metabolic processes is brought about by physiotherapy and there is a more speedy restoration of function. Heliotherapy, diathermy, iodides, rest and proper food are advised. Many cases of adhesions yield readily to treatment.

In some cases of osteomylitis, copperization and untraviolet rays with massage accomplish wonders. Tuberculosis of the bones will respond to ultraviolet treatment when all other means have failed. Ultraviolet in rickets need only be mentioned.

The different types of paralysis are more or less aided by physiotherapy. Only the most skilled operator can accomplish results here. Cerebral paralysis is the most difficult form to treat but even it is sometimes helped by rest, massage and electrical stimulation. In spinal paralysis surgery is first called upon and physiotherapy used as an aid. Hemorrhage of the cord calls for the same treatment. Peripheral nerve paralysis can be aided to a greater degree than can any other form. In infantile paralysis the condition for regeneration is more favorable than in traumatic peripheral paralysis. Stretched muscles that have not functioned for many years but are not paralyzed may be restored by electrical stimulation.

Ulcers are much benefited by physiotherapy. In neuritis the cause must be removed by whatever means is necessary and physiotherapy then used. Sciatica, lumbago and all forms of myalgia yield readily to diathermy. Torticollis responds less readily. The progress of arthritis can sometimes be arrested though it cannot be cured. In neuro-cardio asthenia at least 60 per cent of patients are cured.

Dementia praecox is incurable but mental trouble of the praecox type clears up. Epilepsy *grand mal* cannot be cured but *petit mal* can be.

Biological Reactions of X-Rays: Effect of Radiation on the Nitrogen and Salt Metabolism. Carl F. Cori, M. D., and G. W. Pucher, Buffalo General Hospital. Am. J. Roentgenol. 10:739-745, September, 1923.

THE DATA cover the field of both moderate and heavy x-ray therapy and confirm that of previous investigators as regards nitrogen metabolism. In all cases the total nitrogen was increased in the postradiation periods Of the nitrogen fractions determined, the urea plus ammonia and the uric acid were the only ones which showed any increase.

"In the first two cases * * * which had tumors that could be readily observed, the increase in the total nitrogen was parallel to the decrease in the size of the tumor. Since we also observed an increased excretion of phosphorus, it is very probable that a great part of this increase of total nitrogen was due to the elimination of destroyed cells. In this connection the increased output of urea and ammonia and of the undetermined nitrogen gives a partial insight into the mechanism involved in the decomposition of those cells destroyed by the radiation.

"In Case I the weight of the tumor mass before radiation was estimated at between 200 and 300 gm. It will be seen that there was an increase after the radiation of about 3.6 gm. of nitrogen, corresponding to 22.5 gm. of dry protein. Estimating that the average tumor tissue contains about 10 per cent protein and 80 per cent water it will be seen that 225 gm. of tumor tissue were actually destroyed.

"These experiments also indicate that 'roentgen sickness' is not due to

excessive cell catabolism, since Cases I and II having the largest tumors and greatest increased nitrogen excretion were scarcely inconvenienced by the x-ray treatments, while Case III with the smallest tumor and lowest nitrogen output, suffered a very intense post-radiation reaction.

"The influence of radiation of the inorganic metabolism was most unexpected, in that in all cases a marked retention of chlorides was observed, a retention far greater than could be accounted for by a possible retention of fluids. This is clearly demonstrated in Cases I and II where no decrease in urine volume or gain in weight could be observed. In fact the retention of chlorides was so pronounced in Case II that not even forty-eight hours after a high salt diet was there a very marked increase in the chloride output. In Case III although the urine volume decreased one half, yet the chloride excretion was eight times below its normal value without any gain in weight. How long this chloride retention would have lasted could not be determined in these cases, but animal experiments are in progress which we hope will clear up the mechanism and factors involved in this phenomenon."

Ovarian Tumors Following Roentgen Castration. E. Vogt, M. D. Strahlentherapie 25:470-472, Nov. 4, 1923.

IT IS generally assumed that roentgen ray castration destroys the graafian follicles of the ovary, and that any unharmed follicle may mature later on and yield ova capable of reproduction.

The author calls attention to another feature observed to follow roentgen castration, namely, the rise of cystoma and of ovarian carcinoma in cases where before radiation the adnexa were free from such lesions.

He cites two cases of roentgen castration done for myoma whereupon large cyst formation followed. Microscopically the cysts were found to be pseudomucinous. Two other cases were treated for menorrhagia and developed carcinomata. One case of cylinder-cell sarcoma of the gall bladder developed metastases in the adnexa and cervix following irradiation.

The cyst formation and the development of carcinomata which histopathologically arise from epithelial or germinal structures prove that after irradiation the epithelial cells did not lose the capacity to give rise to malignant tumors. Also the connective tissue may have been affected to some extent as evident from the case in which a cylindrical cell sarcoma was allowed to form.

The author is of the opinion that not only does irradiation not destroy the cellular structures completely, but that the internal secretion of the ovary is not fully done away with. As corroboratory evidence he calls attention to the following facts:

(1) Certain attempts to reduce hypersexuality by irradiation failed, while removal of the ovaries was effective. (2) Fehling's case of osteomalacia did not respond to irradiation of the ovaries, but complete cure was effected through their surgical removal. (3) Young women suffering from pulmonary tuberculosis who were castrated by x-rays, now have a persisting amenorrhea, and show certain unfailing signs of the setting in of the climacteric.

The author concludes that irradiation of the ovary, although followed by amenorrhea, cannot be considered as completely removing it whether considered morphologically or as internal secretory gland.

A. M. PFEFFER, M. D.

The Goitre Problem. W. A. Rush, M. D. Nebraska State M. J. 8: 354-358, October, 1923.

THE AUTHOR insists on the importance of the patient being under the care of a competent internist for supplementary treatment during the period of x-ray treatment.

X-ray treatment is highly efficient and safe in competent hands, it is more economical than operation and it has no mortality.

X-ray equipment has been perfected to a remarkable degree of efficiency and it is possible to estimate dosages with accuracy. Over-irradiation will not occur if treatment is checked by basal metabolism readings.

Observations on the Lateral Position and Other Methods of Examination of the Renal and Gall-Bladder Areas. Sir John Thompson-Walker, M. B., F. R. C. S., and Robert Knox, M. D., M. I. E. E. Am. J. Roentgenol. 10:681-696, Sept., 1923.

THE OBJECTIONS to the lateral position in examination of these areas is that kidney sinks forward and toward the middle line and if its mobility is increased the changes in its relation to the vertebral bodies (the fixed points of a lateral radiogram) are considerable. Also in this position perirenal adhesions will interfere with what might be regarded as a normal variation in the position of the kidney and the renal pelvis may be emptied by the muscular effort of changing position.

Part of the value of a lateral radiogram depends upon comparison with the anteroposterior view and both these views should be taken with the patient in the same position, so it is essential that the lateral negatives should be taken with the patient lying either prone or supine, and the lateral is more preferable for an ordinary kidney negative.

When pyelography is used, a rapid combined method should be worked out and practiced by the surgeon and the radiologist. The essentials are rapidity of action, shortness of exposure and a tube of the proper degree of hardness for the particular conditions. Description is given of a table by which means it is possible to screen from below and take negatives from above and from the lateral aspect in a short time without in any disturbing the patient. A duplitized film with two intensifying screens is used, one on either side of the film.

Lateral radiography may be used alone or with an opaquue catheter (best ones of Paris make) or in combination with pyelography. The catheter with a terminal eye must be withdrawn one-half centimeter after it has passed the full length and been arrested, for if this is not done there will be imperfect filling of the pelvis and remaining calices and because the patient will feel pain when the upper calyx is distended the operator will be mislead into believing that the pelvis is already full. If desired to study the contour of the uretero-pelvic junction, the catheter must then be withdrawn about two centimeters.

The authors have used sodium bromide, 20 per cent solution. It throws a less dense shadow than collargol. The solution must not be stronger than 20 per cent, and must be sterilized by boiling, and oxycyanide of mercury added (1:8,000) to keep it aseptic. Full directions for injection are given.

Interpretation: Accurate anatomical knowledge is absolutely necessary here. The anatomical points upon which localization in an anteroposterior view depends, are the last two ribs, especially the twelfth one, the bodies and transverse processes of the lumbar vertebrae, the crest of the ilium and the oblique outer margin of the psoas muscle. In the lateral position the ribs give no help except to mark the twelfth dorsal vertebra, the bodies and spines of the lumbar vertebrae are the structures by which one is guided here.

The shadow of a normal radiogram can be recognized in a radiogram of the first quality and the particular points in recognition of a normal shadow are given in detail.

Gall-bladder pathology often results in a thickening of the gall-bladder walls which will show in a radiograph properly taken. Gall-bladder postion varies greatly in different individuals. "It may occupy the space between the twelfth rib and the outer border of the

psoas muscle usually occupied by the kidney. The shadow is elongated, pear-shaped, with the apex above. It lies nearer to the twelfth rib than does the kidney shadow and its long axis is not parallel to the outer border of the psoas muscle shadow, as in that of the kidney but bisects the angle between the twelfth rib and the psoas. * * * Very considerable variations are found in the relation of the gall-bladder to the bony landmarks, and this is not always due to the varying positions of the gall-bladder, for the twelfth rib may be long and very oblique, so that the costo-vertebral angle is narrow. The gall-bladder shadow is then in relation to the twelfth rib and last costal space. The long axis may be more vertical or more transverse. In the lateral view the gall-bladder lies anterior to the lumbar vertebrae and reaches as low as the third lumbar vertebra."

There are variations, of course, brought about by disease conditions and these are discussed at length. The divisions of the remainder of the article are: Psoas Abscess; Shadows in the Kidney and Gall-Bladder; Postion of a Shadow in the Kidney Gall-Bladder Area; Size and Shape (of renal and biliary calculi); Density and Uniformity of Shadows; Grouping of Shadows and the Effect of Respiration; Pyelography; Lateral Radiography and Pyelography.

Temporary Suppression of Urine Following Double Pyelography. Henry H. Morton, M. D., Jour. Urology 10:261-265, September, 1923.

THIS IS a case report made for the purpose of calling attention to the danger which is attendant upon doing a pyelography of both kidneys at the same time.

Bromide of soda solution, 25 per cent, was used in the case here reported and there had before this time been no untoward results from a double pyelography in the author's hands.

The patient's history pointed to a calculus in the left kidney or ureter. Urine was cloudy, acid, with a large amount of pus and a moderate number of red blood cells. Cystoscopy showed the bladder to be normal. No shadow showed in either kidney but a shadow of a small calculus was clearly visible in the lower ureter one and one-half inches from the bladder. The pelvis of each kidney was then filled with the solution by gravity method and pyelograms were made. The patient did not complain of pain at the time but on returning to the ward he did so complain. The pain was in both kidneys, lasted throughout the night and complete suppression of urine followed for two days.

Radium Needles in Malignant Growths of the Tongue: The Time Factor. A. James Larkin, M. D., Am. J. Roentgenol. 10:734-735, September, 1923.

CONCLUSIONS: "Standard needles containing 12.5 mg. radium element placed 1 cm. apart and parallel in malignant growths of the tongue yield the best clinical results if left in place eight to ten hours.

"Six-hour application permits of recurrence in situ.

"Twelve and eighteen hour applications produce excessive sloughing with tendency to hemorrhage and such severe reactions that the patient's local and general resistance are seriously lowered."

Roentgen Diagnosis of Duodenal Ulcer. Direct Roentgen Symptoms. Ake Akerlund, Mitt. a. d. Grenzgeb. d. Med. u. Chir. 36:577-589, No. 5, 1923.

THE AUTHOR lays special emphasis on technique, pointing out the numerous difficulties in obtaining a clear projection of the bulb. It is absolutely essential to obtain the best possible views of the cap in carious positions and so project them on the plates. Yet it should not be too time consuming. It should last about fifteen minutes for simpler cases, and about thirty minutes for more complicated ones.

Manual expression of stomach contents, blockage of the pars inferior duodeni, and certain positions will often bring about visualization of the cap. The author takes a series of 12 roentgenograms on 3 plates using a cassette, one-fourth of which is open and the other three-fourths protected with lead. The position of the duodenum is previously determined by fluoroscopy.

Does a duodenal ulcer always produce roentgenologically demonstrable changes? The author is certain that every open ulceration which affects the deeper coats of the duodenal wall, produces changes in form or contour.

The following changes in contour are observed: (1) Projection of the opaque substance into the crater of the ulcer producing a niche. (2) Defect in bulb shadow produced by either scar tissue formation, adhesions or spasm. (3) Flattening or shrinking of the cap produced by shrinkage, spasm or infiltration. (4) Pocket formation or projection in the form of a diverticulum.

The author does not agree with the accepted idea that niche formation in the duodenum is too rare to be considered of practical importance. He finds it just as frequently as in stomach conditions. He found it in 60 per cent of definite duodenal ulcer cases.

The size of the niche is variable. One he found as large as a half of a walnut, the other was barely the size of a pin head.

The site of predilection for the niche is the medial wall of the bulbus. Rarely they are found in the lateral and pyloric borders. Along with the niche, there is very often accompanying retraction and defect formation. It altogether gives the impression of a miniature of the stomach ulcer.

While defects are thought to be due to organic changes, yet a large part of it is purely functional, being due to spasm. The defect may be found in the pyloric, lateral and medial borders. It is more prominent and is usually found on the lateral border. The defect on the pyloric border is pea sized and over the lumen. It is usually produced by a small fissure in the muscularis mucosa. The spastic condition of the cap was found in some cases to increase in the later stages of digestion, which may account for the hunger pains in those cases. Paradoxical retention, (hypermotility with retention) is due to this later supervening spasm.

A flattening in the longitudinal direction giving the cap an asymmetrical appearance is almost always localized on the medial side. It may be mere spasm of the longitudinal musculature, but is very often the result of organic changes. Such retraction when in the basal border gives the appearance of an excentrically placed lumen of the pylorus.

The ulcer diverticulum is a pocket shaped projection of the wall of the duodenal cap. The mucous membrane is usually intact. Their site of predilection is in the ring shaped recess of the cap. They are of two types: The large and indefinitely defined, found in the lateral border, usually proximal to a spastic bulb defect, and the small circumscribed, found on the medial side immediately connected with the sphincter of the pylorus.

Traction diverticulum occurs very rarely.

In comparison with deformities of the duodenal cap shadows, changes in size, position, mobility, motility as well as sensitiveness to pressure, play a subordinate role in diagnosis of duodenal ulcer.

A marked diminution in size of the cap, unless some other deformity can be demonstrated, is to be considered as a generally shrunken cap.

Persisting opaque spots in the duodenal region, while they may be due to retention of barium in ulcer crater, are very often due to some recess or pocket formation without ulceration.

For different diagnostic purposes, the niche finding is pathognomonic. A spastic defect on the lateral and a retraction on the medial side is found exclusively in duodenal ulcer. In a marked eccentric wide open pylorus, it may be assumed with the greatest probability that it resulted from an ulcer. Also when there is a constant, markedly pronounced, localized spasm on the greater curvature it may be assumed with the greatest probability that duodenal ulcer is present.

Deformity produced by gall-bladder conditions can be easily differentiated. They usually are very variable in different positions, and a normal cap can be demonstrated even when entirely imbedded in adhesions. Pericholecystic adhesions show fine serrations, which often disappear when position is changed.

New growths such as papillomata or polyps give typical findings which are never confused with duodenal ulcer.

A. M. PFEFFER, M. D.

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